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GREAT BARRIER REEF EXPEDITION

1928—29

VOLUME V

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION

1928–29

SCIENTIFIC REPORTS

VOLUME V

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BY

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ON THE ROCK-BORING BARNACLE, LITHOTRYA VALENTIANA

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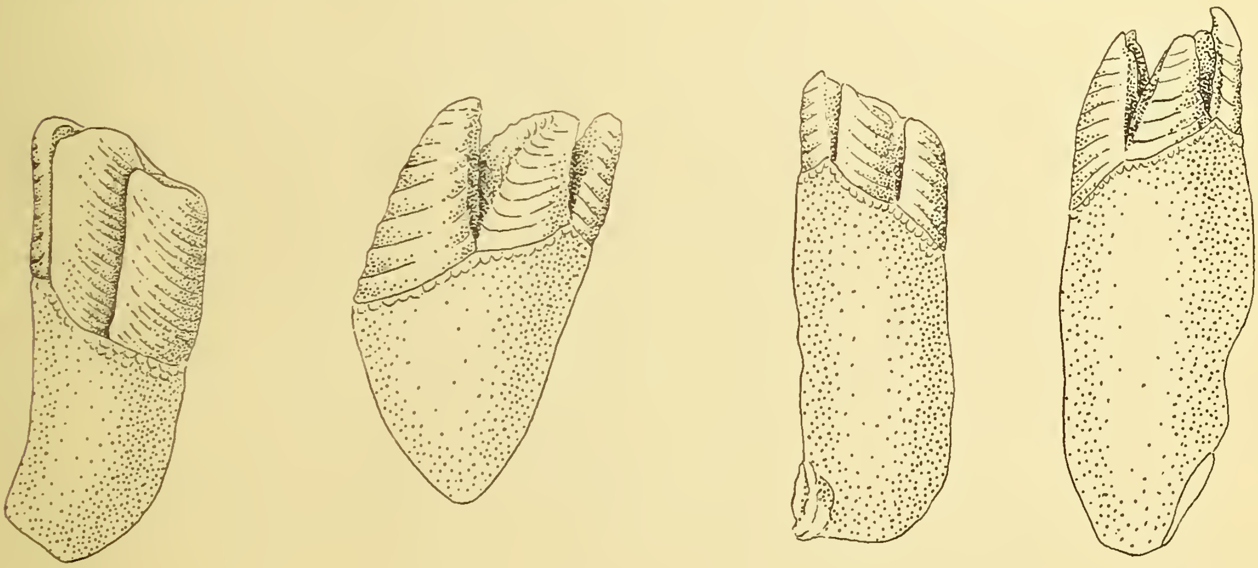
WITH SEVEN TEXT-FIGURES AND TWO PLATES.

THE original description of the genus *Lithotrya* was published by Sowerby in 1822. Since then eight species have been described. Of these *L. rhodiopus*, Darwin, is uncertain. Of the remaining seven, Seymour-Sewell (1926, p. 271 and p. 326), from a study of *L.*



a. b. c. d.

TEXT-FIG. 1.—(*a*) Original figure of *Lithotrya truncata* (= *Anatifa truncata*); (*b*) Darwin's figure of *Lithotrya truncata*; (*c*) and (*d*) Gruvel's figures of *Lithotrya valentiana*. The outlines of these copies have been reproduced from the originals photographically.

nicobarica, Reinhardt, has recently grouped together five as " representatives of a single widely-distributed and somewhat variable species ". If he is correct, these forms must all be described as *L. dorsalis*.

The two remaining species are *L. valentiana* and *L. truncata*. The former was described by Gray in 1825 as *Conchotrya valentiana*, and the latter by Quoy et Gaimard in 1834 as *Anatifa truncata*.

Gray's genus and species are defined as follows (1825, p. 102): " Shelly plates, five; two pair ventral, and one plate dorsal; peduncle —— ? Lives in holes in shells."

C. valentiana : " Shelly plates, thick, transversely lamellated. Inhabits Red Sea in the valves of *Ostrea Cucullata*, Born ; *Lord Valentia.*"

Quoy et Gaimard (1834, vol. iii, p. 636) describe their species thus : "Anatifa, subcylindrica, breviter pediculata, lutescens ; valvis crassis, rectis æqualibus, postice truncatis, transversis striatim ; pedunculo granulato."

No further account of these two forms was published until Darwin wrote his monograph on Cirripedes in 1851. Now it is obvious from the original diagnoses quoted above that at this time it was highly probable that the name *A. truncata* was synonymous with *C. valentiana*, and yet Darwin, who gave a full account of these two supposed species, made a sharp distinction between them. For his study* he had the original specimens of *C. valentiana*, but not those of *A. truncata.* However, a good figure had been published of the latter (Text-fig. 1*a* and Quoy et Gaimard, pl. 93, figs. 12–15). Now what Darwin figured under the name *Lithotrya valentiana* is, of course, correct, in the sense that the figures were drawn from the type-specimens, but also it is obvious that these figures depict a form closely similar to the figure of *A. truncata.* On the other hand, what he figures as *Lithotrya truncata* (Text-fig. 1*b*) is quite different from the original figure, and it is a mystery why Darwin made this decision. He lays great stress on the shape of the valves in describing the difference between the two forms, and yet the valves of his *L. truncata* are quite different from those shown in the original plate. They are not truncated in any way—they are all perfect, while in the original description it specifically states " valvis crassis . . . postice truncatis ". If, therefore, the shape of the valves was to be used as a diagnostic feature, Darwin had no right to name his specimen *L. truncata.* He should have made it the type of a new species, and at the same time he should have established the synonymy of the two forms and done away with the name *A. truncata.*

The matter is further complicated by the fact that Darwin did not publish a complete figure of the undisturbed valves of *L. valentiana* except for a vertical view of the capitulum. This was left to Gruvel, who, in 1902, published two figures under this name, one of which closely resembles the original picture of Quoy and Gaimard of *A. truncata,* while the other is quite different and similar to Darwin's *L. truncata* (Text-fig. 1, *c* and *d*).

Darwin distinguishes the two species almost entirely on the differences between the shapes of the valves, and of these, it is the terga that he stresses most. He states (1851, p. 372), referring to *L. valentiana,* " The valves . . . generally resemble those of *L. truncata* ; scarcely any appreciable difference can be detected in the scuta ". It cannot be maintained, however, that his figures support this statement. It is obvious, by comparing Plate VIII, fig. 5*a*, which is an inner view of the terga and scuta of *L. valentiana*, with Plate IX, fig. 1*b*′, *b* and *c*, which represent the same parts of *L. truncata*, that the scuta and terga are markedly different. Of the latter he states (p. 372) that there is " a fold or indentation . . . : this fold, . . . descends below the roughened knob at the upper angle of the carinal margin, which is not the case with the slight fold in the same place in *L. truncata* ", and this was the main, and probably the only, difference that he saw between the two species. Now I have been able to examine the two original specimens of *L. valentiana* on which Darwin worked, and while his description of the tergum

* Darwin's material is still in the collection of the British Museum (Natural History). Dr. I. Gordon in a letter states : " The two small dried specimens of *L. valentiana* described by Darwin are still in our collection, mounted on a small wooden block ; there is also a single specimen of *L. truncata* labelled by Darwin. The *L. valentiana* material must be Gray's original types (' Annals of Philosophy ', 1825 (2), x, p. 102), since, on the back of the block, is Gray's signature under the name ' *Conchotrya valentiana.*' "

applies to the larger specimen, it is not possible with any certainty to distinguish the limits of the fold to which he refers in the smaller. Moreover, even in the larger specimen the fold is certainly not as pronounced as drawn by Sowerby and figured by Darwin (1851, pl. viii, fig. 5*a*). In addition to this the shape of the terga in the two specimens differs to such an extent that it is difficult to imagine how Darwin could have based a specific difference on such a variable structure.

The only other point that I can find in Darwin's description that may have influenced him is that he states that the inner internal crest of the carina of *L. valentiana* is square " instead of round, as in *L. truncata* " (p. 372). Unfortunately, again the figures do not support this. In both cases they show a squarish crest rounded off at the edges.

Thus the position in which Darwin left matters in 1851 is, I submit, that (1) he described a new form as *Lithotrya truncata* when there was no evidence that it agreed with the original *Anatifa truncata* of Quoy and Gaimard, and (2) he described specific differences between his new *L. truncata* and the original *Conchotrya valentiana*, Gray, for the existence of which there was no real evidence.

The next authority to study these two species was Gruvel (1902). He described a new specific difference in the complete absence of the lateral plates in *L. valentiana*. Darwin, referring to this species, stated (p. 851, p. 373), " Latera lost; no doubt they were rudimentary ", while in *L. truncata* he stated that they were rudimentary (p. 369), and were " represented by mere stiles (likes strings of beads), and are even less in width than the rostrum " (p. 335). Gruvel, however, is much more emphatic. He states (1902, p. 250), " Malgré sa ressemblance avec *L. truncata*, il faut faire de *L. valentiana* une espèce différente, car un caractère essentiel les distingue ; c'est que dans la première il existe des plaques latérales, rudimentaires il est vrai, tandis qu'elles sont *absentes* dans la seconde ", and further, " Dans les deux échantillons examinés par Darwin, il n'y avait pas de plaques latérales et, étant donné le mauvais état de conservation dans lequel ils se trouvaient, l'illustre naturaliste avait pensé que si elles n'existaient pas, c'est qu'elles avaient peut-être disparu. Il n'en est rien.

" Si elles n'existent pas, c'est qu'il n'y en a pas. Je les ai vainement recherchées et cependant, mes échantillons étaient en excellent état ".

Now despite the fact that Darwin described these lateral plates as styliform in *L. truncata*, that is, latera quite unlike those of any other barnacle, and that Gruvel uses their presence and absence to distinguish two species, no one, as far as I can see, has ever figured them.

Unfortunately Gruvel describes the mouth-parts of specimens which he identifies as *L. valentiana* and states that the mandibles are asymmetrical. Certainly his figures (pl. xii, figs. 28 and 29) show a marked difference between the right and left mandible. Now he only had two specimens (p. 250), and it is not certain that he dissected both. Apart from this, since the original specimen of *L. valentiana* consisted of shells only and contained neither mouth-parts nor even body, he must have based his identification primarily on the valves ; and, as I have already stated, one of his figures closely resembles Darwin's figure of *L. valentiana*, and hence the original picture of *A. truncata*, while the other is much more like Darwin's picture of *L. truncata*. I cannot see, therefore, that Gruvel made out a case for the identification of his specimens as *L. valentiana*. In any case, he makes little reference to this asymmetry of the mandibles and stresses the absence of latera (p. 250).

Nilsson-Cantell (1921, p. 216), on the other hand, does not place much value on the

absence of latera as a specific difference. He states, " Dieser Unterschied scheint mir weniger wesentlich, da es auch oft bei Exemplaren von *L. truncata* schwer ist, die Lateralia zu finden ", and includes in his diagnosis of *L. truncata* (1921, p. 213), " Lateralia können mitunter fehlen ". Yet he also is prepared to accept the two species *truncata* and *valentiana*. He apparently used the mouth-parts for the identification of his specimen, for, referring to a new subspecies of *L. truncata*, he states (p. 217), " Auch kann ich die Tiere aus mehreren Gründen nicht zu *L. valentiana* rechnen, welche Art hinsichtlich der Mundteile abweicht . . . ". But here, again, there is a difficulty. For his comparison he must have accepted the only description of the mouth-parts of *L. valentiana*—that of Gruvel, which I have just mentioned—but his own description of the mandibles of *L. truncata* is quite different from the only previous description—that of Darwin (1851, p. 370). Darwin states that the mandibles have " eight pectinations between the first and second main teeth and three between the second and third teeth, . . . ". Nilsson-Cantell merely states (1921, p. 214), " Zwischen Zahn 1 und 2 ungefähr doppelt so viele kleine Zähne, als zwischen Zahn 2 und 3 "—and then figures a mandible with 14 pectinations in the first gap, instead of Darwin's 8, and 6 in the second instead of 3. Again I cannot see what real evidence Nilsson-Cantell was using when he decided that the form was *L. truncata* according either to Darwin or to the original account.

The position, therefore, as I see it at present, is that Darwin (1851), by not referring to the original figure of *A. truncata*, overlooked the fact that this form had previously been described as *C. valentiana*. Gruvel (1902) then described the absence of latera and the asymmetry of the mandibles in *L. valentiana*, when he had no evidence that his specimens belonged to this species rather than to Darwin's *L. truncata*. And finally, Nilsson-Cantell (1921) described the specific characters of the mandible of a form which he names *L. truncata* when this description disagrees with that of Darwin.

The Great Barrier Reef Collection consists of 30 complete specimens all collected in the Boulder Zone of Low Isles Reef. In general shape they show every gradation, from forms which closely resemble the original specimens of *C. valentiana* and the original figure of *A. truncata* (Plate I, fig. 1), to those which are similar to the form described by Darwin as *L. truncata* (Plate I, fig. 2, and Text-fig. 2). As regards the " latera ", these may be present or absent, and in two specimens, while the " lateral plate " is present on one side, it is absent on the other (Plate I, figs. 3 and 4). On these characters alone, therefore, there seems no reason why these specimens should not all be described as *Lithotrya valentiana*.

SIZE AND AGE.

The measurements of specimens Nos. 1–26 are given in Table I. As Seymour Sewell (1926, p. 273) points out with regard to his collection of *L. nicobarica*, the total length of the animal from the tip of the capitulum to the opposite end of the peduncle is of little significance owing to the varying state of contraction of the stalk. In addition, in *L. valentiana* the extreme variation in the degree to which the valves may be worn down makes this measurement useless for comparison. Thus one, specimen 3 (Plate I, fig. 2, and Text-fig. 2), has almost complete valves, while in another, specimen 7 (Plate I, fig. 5), the greater part of the valves has been worn away.

Using the width of the capitulum, that is, between carina and rostrum, the measurements group themselves roughly about a mean of 7·5 mm., with maximum numbers

TABLE I.

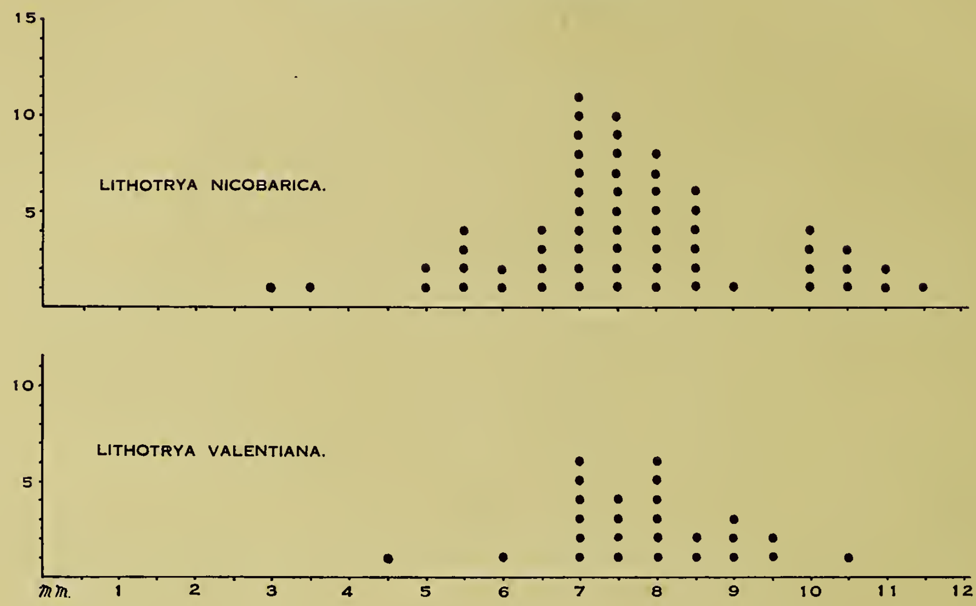
Specimen number.	Length (mm.).	Width at base of capitulum (mm.).	Scutum (mm.).	Carina (mm.).	Latera.* Left.	Latera.* Right.	Remarks.
1	20·5	8·0	10·0 9·0	5·0	56	3	Eroded more on one side than the other.
2	22·0	7·5	10·5 8·5	6·0	—	2	Lateral on one side only.
3	10·0	4·5	5·5	3·0	—	—	Latera absent. Typical *L. truncata* according to Darwin.
4	15·0	8·5	11·0	4·0	3 3	6 4	—
5	18·0	9·0	10·0	6·0	6(3)52	(1)9(2)32	On left side apical style is not the longest.
6	22·0	9·5	11·0	4·0	—	—	Very much overgrown. Latera, if any, obscured.
7	15·0	8·5	8·0 6·0	3·0	—	—	Latera absent.
8	23·0	9·0	11·0	6·0	6	3732	—
9	25·0	8·0	11·0	7·0	257	34	—
10	20·0	7·5	9·5	4·5	—	6	Latera on one side only.
11	20·0	7·0	10·0	4·0	2	—	Latera on one side only. Left side typical *Anatifa truncata*, Quoy et Gaimard.
12	17·5	9·0	8·0	3·0	—	—	Latera absent.
13	19·0	7·5	8·0	6·0	222	222	—
14	20·0	8·0	9·0	4·0	33	2	—
15	12·0†	7·0	9·0	4·5	23	4	
16	17·0†	7·0	6·0 7·0	4·0	22	4	—
17	18·0	8·0	7·0	5·0	23	62	—
18	22·0	10·5	12·0	7·5	222243	552	Apical styles curve inwards at tips between carina and terga
19	18·0	9·5	10·0	4·0	223	222	—
20	17·0	7·0	9·0	4·5	55	52	—
21	14·0	7·0	10·0	4·0	35	3	—
22	13·0	7·5	8·0	2·0	31	12	Apical styles not the longest.
23	16·0	8·0	9·0	4·0	224	2632	—
24	15·5	8·0	10·0	4·0	2	22	—
25	12·0	7·0	7·0	2·5	2	3	—
26	13·0	6·0	8·0	5·0	2	4	—

* Each figure represents the number of swellings in a lateral style. The figure in block type denotes the apical style; the others, those on either side. Where the figure is enclosed in brackets, this indicates that the style was obviously broken short.

† Shrivelled before fixation.

at 7·0 and 8·0 mm. Although only 26 specimens were available for measurement, and this was made to an approximate accuracy of 0·5 mm., the results are the same as those obtained by Sewell for *L. nicobarica* (Table II). Sewell, however, deduces from his measurements that the individuals show a grouping with four year-stages. His first-year group consists of 2 individuals with minimum size 3 mm.; second-year, 8, with minimum size 5·0 mm.; third-year, 39, with minimum size 6·5; and the fourth-year, 10, with minimum size 10·0 mm. Now his smallest specimen, from the point of view of collecting, was relatively large, so that there is no reason to assume that they were much more difficult to find than the larger. Also as he states (1926, p. 272), the animals occurred in groups in the rocks which were presumably broken open and carefully searched. It is to be deduced,

TABLE II.—*Showing Measurements of 60 Individuals of* Lithotrya nicobarica *and 26 Individuals of* L. valentiana.



therefore, that the collection represented fairly all sizes of individual present in the rock. Further, *Lithotrya* has no asexual method of reproduction. Under these conditions surely the first-year group must be larger than that of succeeding years—or rather, since we know nothing about the relative intensity of spawning in the years immediately preceding 1925, when the specimens were collected, we must assume this to have been approximately the same year by year, and hence the second and later year-groups must represent those that survive from preceding years. In other words, the first-year group must be the largest.

Sewell's figures for *L. nicobarica* and those now published for *L. valentiana* suggest merely that the two species grow to a size of at least 7 mm. diameter between the spawning time and the time when they were collected—10th April, *L. nicobarica*, and 31st May, *L. valentiana.*

In both series there are individuals considerably larger than the average, and in the case of *L. nicobarica* they form a separated group. Since they are smaller in number than the main group, it is safe to deduce that they may represent a second year, or even an older group.

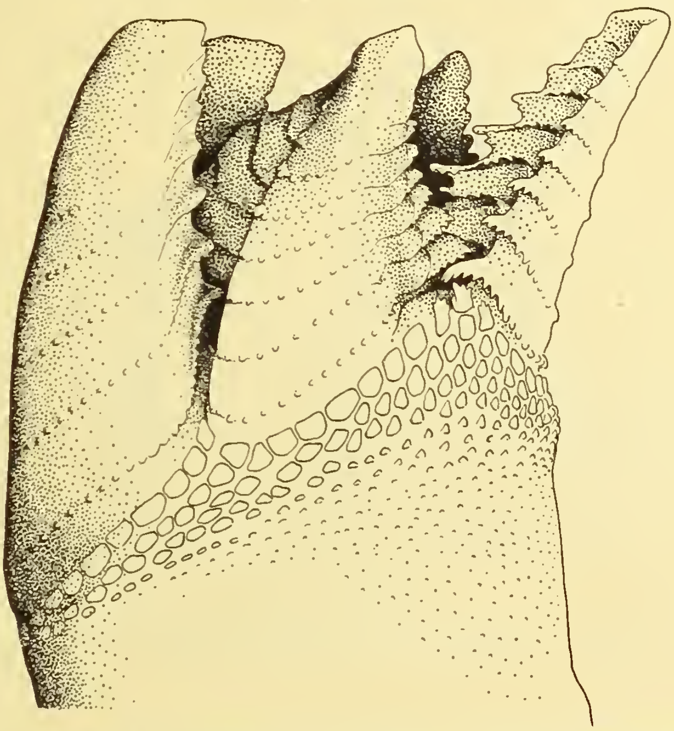
Also in both series there are small specimens separated considerably from the main group. In *L. valentiana* the one small specimen, No. 3, is by far the most perfect in the collection. It is possible that these small individuals, few in number, represent the products of a second subsidiary spawning period.

SHAPE OF VALVES.

It is not possible to publish illustrations of all the specimens of the collection, but it is clear, from the photographs and text-figures, that they vary markedly. Specimen 3 (Text-fig. 2 ; Plate I, fig. 2) corresponds closely to the form figured by Darwin as *L. truncata,* while specimen 11 (Plate I, figs. 1 and 6c) agrees with the original figure of *L.*

truncata and with the type-specimen of *L. valentiana*. In fact, it is possible in this small collection to copy any of the published figures of either species, and also to produce a complete series of intermediate forms.

Darwin, as I have pointed out (p. 2), used the shape of the individual valves as a specific criterion. In *L. valentiana*, in considering this point, it is clear that the apical margins cannot be used for comparison, for they are worn down to varying degrees. Thus, in Specimen 3 only the tips of the scuta were slightly worn away, while Specimen 11 had its valves so ground down as to appear as a transverse section in apical view (Plate I, fig. 6*c**). Specimen 7 (Plate I, fig. 5, and Text-fig. 3) was worn away to an even greater



TEXT-FIG. 2.—*L. valentiana.* Capitulum of Specimen 3 viewed from right side. Carina to right. × 16.

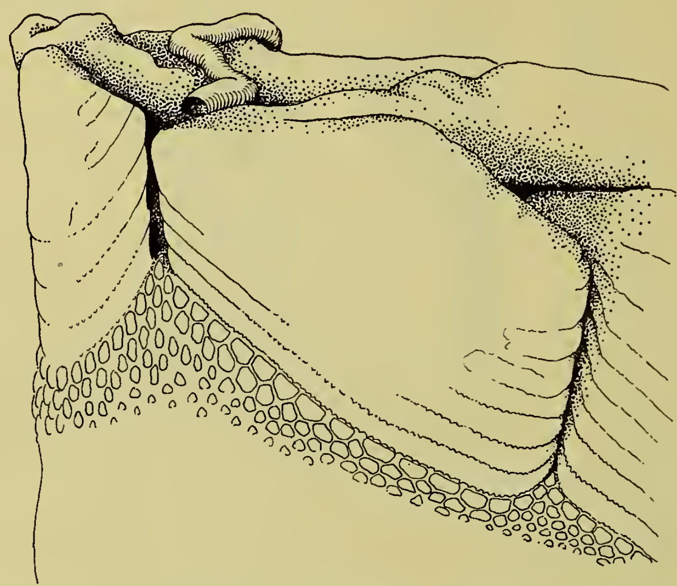
extent, and, further, as in several other specimens, it had been ground down unevenly, so that the valves of one side were definitely shorter than their fellows. Also, and in the majority of specimens, the apical surface was covered with a growth of sessile organisms which, in itself, made it difficult to see their actual margins.

The basal margins of the valves, on the other hand, should be unaffected by erosion. In Plate I, fig. 7*a*, *b*, *c*, are shown photographs of the inner view of the isolated valves of three specimens chosen at random from the collection. The isolated scuta, to the right of the figure, show marked differences. The ridge near the tergal margin which fits into the groove on the outer surface of the tergum (compare Plate I, fig. 6*b*, *c*) is massive in *c* and slender in *b*. The basal angle of the scuta also differs, but as the plates are curved

* In Darwin's monograph (1851, pl. viii, fig. 5*b*) there is a drawing by George Sowerby of the capitulum of *L. valentiana*—the type-specimen—seen vertically from above. From a study of the original specimen it is obvious that the scuta have been figured relatively too large and the terga too small. A correct drawing would correspond closely with Plate I, fig. 6*c*.

the photographs do not demonstrate this conclusively. Actually the angle of the scutum in *c* is more obtuse than that in either *a* or *b*.

It is the terga, however, that vary most, and as I have previously pointed out (p. 2) it was on the inner shape of the terga that Darwin based his distinctions between *L. truncata* and *L. valentiana*. The markedly different shape of the tergum shown in *c* from that in *a* can be seen from the isolated terga. But for comparison the best photographs are those to the left of the figure showing terga and scuta joined together in their natural position. From these it can be seen that, while in *a* the lower scutal margin of the tergum slopes continuously upwards away from the peduncle, in *c* it bends at an angle so as to run almost horizontally, while *b* shows an intermediate type.



TEXT-FIG. 3.—*L. valentiana*. Capitulum of Specimen 7 viewed from left side. Carina to left. The tube growing on the right tergum is that of a Vermetus-like Gastropod. × 11.

The carinae of the three specimens also show a graded series. The inner ridges on the carina *a* show the outline of a truncated cone, while those of *c* have the appearance of an inverted W.

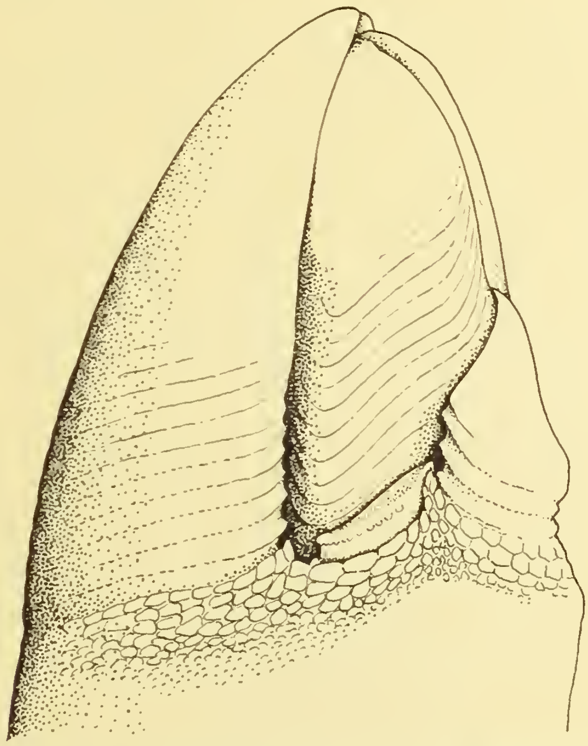
In only one specimen (No. 7) was the rostrum complete (Plate I, fig. 5); in all the others it was broken off near the base. It shows growth ridges laterally, corresponding to the ridges on the outer surface of the other valves, but as this specimen was so very much eroded, it was not possible to see whether the number of ridges on the rostrum agreed with that on the other valves. Six ridges can be counted and six at least on the other valves, but it is uncertain how many had been rubbed off the latter.

THE LATERA.

In all the species of *Lithotrya*, with the exception of *L. valentiana* and the form described by Darwin as *L. truncata*, the latera are well-marked plates and consist of one pair only. Darwin states (1851, p. 333), " I presume that they are homologous with the carinal latera in Scalpellum ". They " are remarkable from being placed over the carinal

half of the terga, in an oblique position, parallel to the lower carinal margin of the terga" (1851, p. 335).

The capitulum thus consists, when the latera are present, of eight plates, and these are sharply separated from the peduncle. The line of demarcation is marked by a zone of scales, which diminish in size towards the base of the peduncle. Towards the capitulum they are arranged in rows following the basal margins of the capitular plates, but as they diminish towards the base, so their arrangement becomes irregular (Text-figs. 2, 3 and 4). It can be stated, therefore, that the capitulum is separated from the peduncle by a definite row of scales in the form of a girdle.



TEXT-FIG. 4.—*Lithotrya dorsalis*. From a specimen in the Manchester Museum. Viewed from right side. Carina to right. × 8.

This girdle does not run in a smooth curve round the peduncle from rostrum to carina; on either side it is bent upwards towards the tip of the capitulum, in two places forming angles. One of these is relatively small, and projects slightly between the base of the scutum and tergum. The other is much more marked, and projects between the carina and tergum (Text-fig. 3). But in *L. dorsalis* (Text-fig. 4), which can be taken as a species bearing typical latera, these plates overlie the carinal side of the terga, so that it can equally be stated that the girdle projects as an angle in between carina and latera. The important point is that there is no angle projecting between the lateral plate and the scutal part of the tergum. Thus, if the girdle were removed as a complete ring, then cut through near the rostrum and mounted flat, it would show four marked angles along its capitular margins. Two of these would be large and near the middle of the preparation, and would represent the carino-tergal angles, while on either side they would be flanked by the smaller tergo-scutal angles.

Now in four specimens of *L. valentiana* I have removed this girdle (Plate II, figs. 8*a*, *b*). To do this I place a very fine scalpel down the outer face of the scutum near the rostrum and underneath the girdle scales; then make an incision through the girdle at this point, and by lifting up one of the cut edges and using the scalpel it is possible to strip off the girdle complete. In each case, when the supposed latera were present, they came off with the girdle—they formed, in fact, the apical scales of the carino-tergal angle.

This fact alone suggests that in *L. valentiana* the real lateral plates are absent, and what have been taken as latera are simply modified scales of the girdle, which should be referred to as sublateral scales. There is further strong evidence to support this view.

In *L. dorsalis* (Text-fig. 4) the latera take no part in the formation of the girdle of scales, and are merely a pair of plates in the primary capitular series—carina, latera, terga, scuta and rostrum—which form a massive and compact capitulum quite distinct from the girdle. These plates, as in all other Cirripedes, are joined together very strongly by muscles or ligaments. In removing the girdle from *L. valentiana* it comes away quite easily until the rostrum is reached. For the sake of convenience it is best to attempt to remove this and mount it with the rest of the girdle, but because it is part of the capitular series and not of the girdle, it is attached very firmly to the scuta and is difficult to remove. It would be expected, therefore, that if the supposed latera were in fact the real latera, they, too, would be firmly attached to the adjacent plates—the carina and terga—and would be difficult to remove with the adjacent girdle scales. Actually they come away just as easily as the remainder of the girdle.

A more important point is the number of these supposed latera. Darwin in his description of the genus *Lithotrya* refers to one pair only (1851, p. 335), and in his description of the form which he diagnosed as *L. truncata* again he only refers to one " rudimentary " pair (1851, p. 369). In all the forms which Sewell has shown should be referred to as *L. dorsalis* (see p. 1), the single pair of latera are similar in pattern to the terga, which they overlie. The only difference lies in their small size and their shape. They are roughly triangular plates, with their bases coincident with the bases of the terga. Now in *L. valentiana* Darwin states (referring to his *L. truncata*) (1851, p. 369), that the latera are " rather smaller than the rostrum ; almost cylindrical, slightly flattened, enlarged at each zone of growth, with one or two sharp teeth or spines on both faces ; imperfectly calcified; . . . ". And again (1851, p. 335), " the latera are represented by mere stiles (like strings of beads), . . . ". Clearly, then, these latera are markedly different from those of *L. dorsalis*, and, in fact, as I have pointed out (p. 3), are unique as Cirripedian capitular plates. In Plate I, fig. 3, is a photograph of specimen No. 10, and this shows very clearly the lateral plate as a " mere stile "—" like a string of beads ". There can be no doubt therefore that the Great Barrier Reef Collection includes specimens showing the same type of latera as Darwin's *L. truncata*. To confirm this I inspected the original specimen and was able to make out the remains of these structures—at least on one side. Unfortunately the specimen has been coated with wax and is mounted on a board. On the exposed surface the lateral plate can be seen, but it has apparently been broken since Darwin examined it, as it is very short. It shows the moniliform swellings, but is too short to describe as a string of beads.

In the present collection some specimens show no lateral styles (Plate I, fig. 2). Others, such as specimen No. 10 (Plate I, figs. 3 and 4), show a lateral style on one side only. This fact alone is sufficient to establish the fact that they are not latera, but more

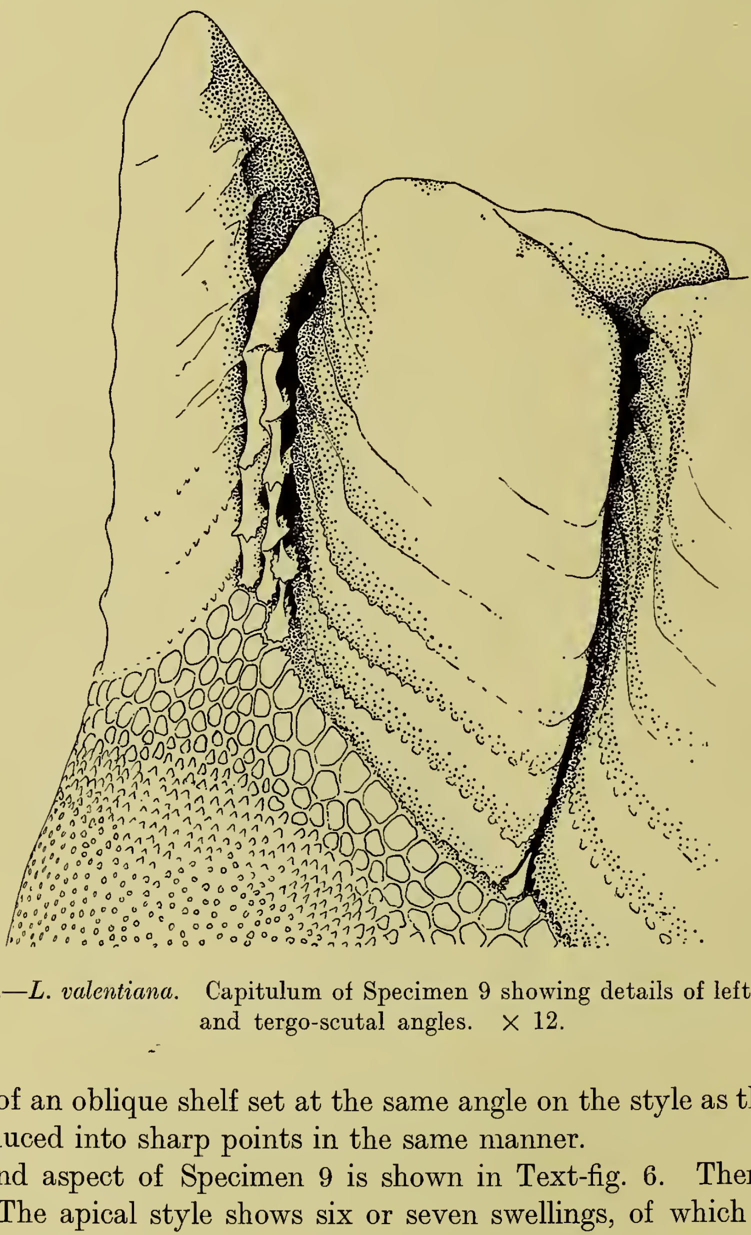
interesting is the fact that the majority show a group of such styles always in the typical position at the apex of the carino-tergal angle, but varying in number from one to six (specimen No. 18, see Table I). Now if it is assumed that, when only one pair of monili-

TEXT-FIG. 5.—*L. valentiana.* Left carino-tergal angle of girdle of Specimen 1. × 34.

form lateral styles is present, these are homologous with the lateral plates of *L. dorsalis*, then this argument fails in those specimens where there are more than one pair.

The shape, and more especially the sculpturing on the moniliform swellings of the styles, gives further evidence that they are related to the scales rather than to the plates.

Text-fig. 5 shows the left-hand carino-tergal angle of the girdle of specimen 1. There are two styles, of which the longer grows out of the apical scale. Counting the basal scale as the first zone of growth it shows markedly six distinct zones, while its neighbour shows five. The more distal swellings are indistinct. They have obviously been worn away in the same way as the more apical growth-ridges in the capitular plates and, in addition, are overgrown by a mat of algae and polyzoa. However, the first swelling above the base on the longer style shows clearly the same shape and sculpturing as the basal scale itself.



Text-fig. 6.—*L. valentiana.* Capitulum of Specimen 9 showing details of left carino-tergal and tergo-scutal angles. × 12.

It has the form of an oblique shelf set at the same angle on the style as the base, and with its margins produced into sharp points in the same manner.

The left-hand aspect of Specimen 9 is shown in Text-fig. 6. There are three sub-lateral styles. The apical style shows six or seven swellings, of which the lower three show the sculpturing of the scales; the adjacent style shows five swellings, all of which, except the apical, show the toothed flange, while the third style shows only two swellings, but these show even more clearly the similarity between the swellings and the girdle scales.

All the scales of the peduncle, even the smallest, contain a single minute central canal supposed to contain a nerve (Gruvel, 1905, p. 359). The capitular plates, on the other

hand, are penetrated by many such canals and, further, in sections of the decalcified plates, they appear to be arranged in rows, as if a new row were added at each growth zone. Now in the sublateral styles of Specimen 16 (Plate II. fig. 8*c*), which bear only two or three swellings, a single canal can be seen running the length of the style.

FORMATION OF SUBLATERAL STYLES.

Darwin (1851, pp. 61 and 336) has described the act of moulting in the genus *Lithotrya*, and Sewell (1926, p. 273) has recently published a concise summary of the process. The characteristic feature is that at each moult the cuticular covering of the peduncle is cast off, while that of the capitular plates remains. Immediately after each ecdysis the capitular plates grow downwards towards the peduncle, adding a new zone to their lower margins. As the animal continues to grow the plates thus become scarred with a series of ridges, each ridge recording a moult.

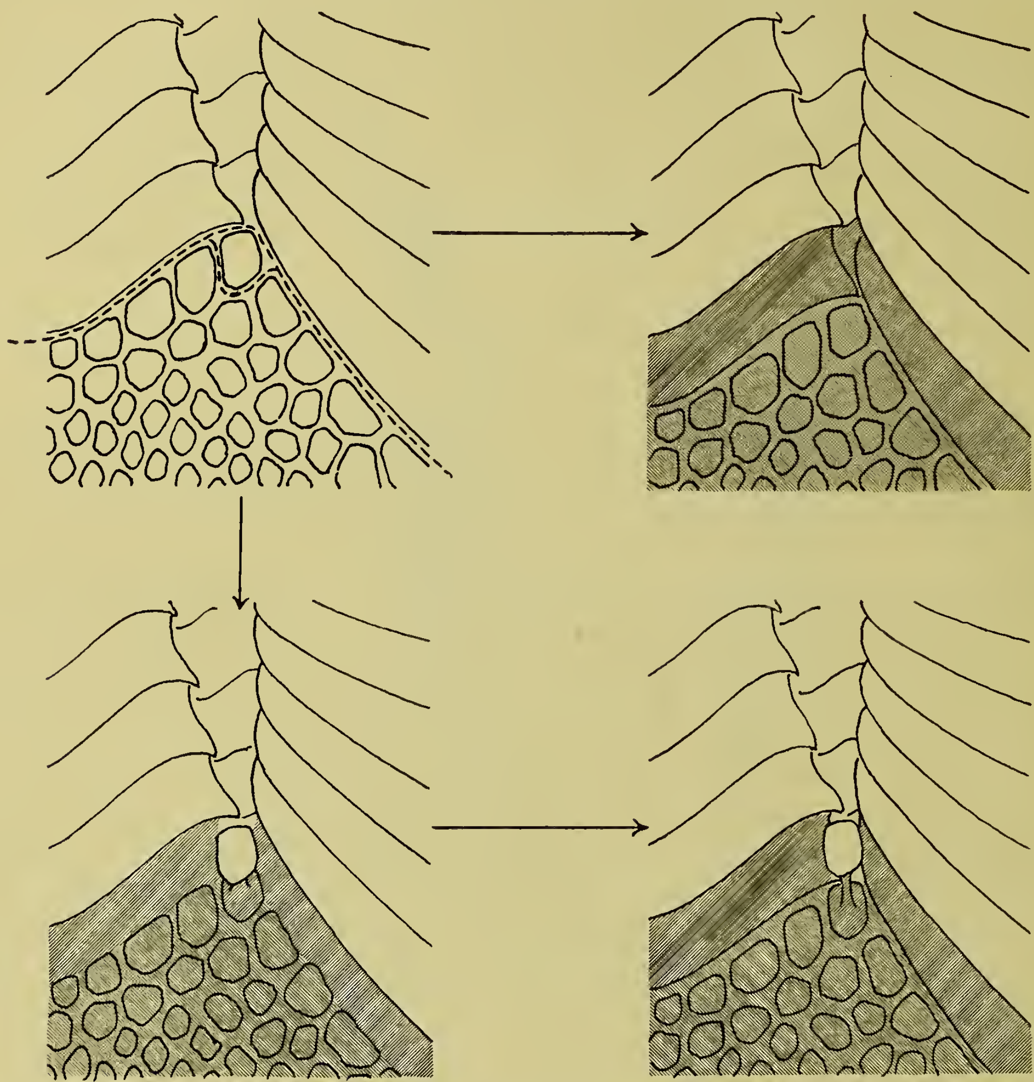
After each moult a new cuticle hardens over the peduncle, but also over the new zone on the capitular plates, and joins on to the old capitular cuticle, so that the whole body is covered with a continuous cuticular covering.

Clearly, at each moult this continuous cuticle must split along a line which separates capitulum from peduncle, that is, along the upper edge of the girdle (Text-fig. 7). The specimens in this collection I consider indicate that the presence or absence of sublateral styles depends on a slight variation in the course of this split.

When the capitular plates add on their new growth it can be said that in so doing they push the girdle downwards to a distance equal to their growth zone. As the new calcareous laminae and cuticular coverings are added on the lower margin of the plate, so, of necessity, must the girdle scales be forced away from the older parts of the capitulum.

Now, in those specimens, *e. g.* No. 3 and No. 10 (left side), where there are no sublateral styles, the exuvial split follows accurately the capitular margins of the girdle. In the other specimens I suggest that the split, instead of passing over the capitular side of the sublateral scales at the apex of the carino-tergal angle, passes along their peduncular margins (Text-fig. 7). This would result in these apical scales remaining connected to the capitular plates by the covering of cuticle—or, more accurately, the cuticular covering of the scales would remain in connection with the cuticle of the capitulum, for the exuvial split concerns the cuticle only and not the underlying tissues. In any scale or plate we can consider the external cuticle, covering the underlying sheet of ectoderm, which may be termed the centre. At ecdysis each scale centre loses its cuticular covering and forms a new one, while each plate-centre retains its cuticle, and forms additional cuticle to cover its new growth. In the case where, as I have suggested, the exuvial split passes along the peduncular margin of the apical girdle scales, the cuticle remains in contact with the capitulum, while the centres remain in their normal position in regard to the other scales. Hence, as the new growth is added to the capitular plates, the centres of these apical scales will be pushed away from their cuticle. But all the time, during this process, the scale centres will be secreting their new cuticle, so that at the end of the growth period the old cuticle of the scale will remain in its original position relative to the old cuticle of the capitulum, and at the same time connected by a *cuticular* connection to the new cuticle of the scale. The growth of the plate centres and of their overlying cuticle is neither continuous nor uniform. Sections show that the new calcareous growth added is not

homogeneous, but in the form of laminae, and this is reflected into the cuticle. At the beginning of each growth period, and almost to the end, thin uniform laminae of calcareous matter and of chitin are deposited. At the end, however, the massive layer is formed bearing the elaborate sculpturing which makes the edge of the growth zone so conspicuous. This same process, I suggest, occurs when the cuticle of the apical scales remains



Text-fig. 7.—Diagram illustrating suggestion as to formation of moniliform sub-lateral scales in *L. valentiana*. In the upper left-hand figure the dotted line represents the positions of the exuvial split. When the split passes above the apical scale of the girdle, it leads to the absence of " lateral " (top right), and when below, to their presence (bottom right).

attached to the capitular cuticle. At first, as the cuticle of the scale is pulled away from its underlying scale-centre, thin uniform laminae of chitin are deposited (Plate II, fig. 8*d*), but at the end of the growth-period the thick sculptured layer of chitin is deposited. The result will be that the old cuticular scale will be carried upward in a capitular direction, and at the same time will remain connected with the new sculptured cuticle by a stalk. If this process is repeated at each ecdysis, it will result in a styliform scale bearing

sculptured swellings at intervals, each swelling representing the cuticular covering of an apical scale that has been dragged away from the peduncle during the growth periods.

If my suggestion is correct, then it follows the distance between the moniliform swellings on the sublateral styles should be equal to the distance between the growth-zones on the capitular plates. The photographs and figures show that this is so. A more important result, however, is that the styles should be entirely cuticular. Darwin (1851, pp. 335 and 369) states that they are "imperfectly calcified". In Specimens 16 and 13 (Plate II, fig. 9), where there are three sublateral scales, each of a simple, dumb-bell shape, it can be seen, even in the whole specimens, that they consist entirely of a yellow-brown transparent chitin and contain no opaque calcareous centre. In the girdles which I have mounted it can be seen that the lower parts of the styles, which are still clear and not overgrown by polyzoa, etc., consist largely, if not entirely, of chitin. They clear well in euparal, but may retain a dark central mass in the swellings. I believe that these dark zones do not represent calcified matter, but simply internal zones that have not dehydrated and so remain opaque in euparal. The calcareous centres of the peduncular scales become relatively transparent, so that if these opaque zones in the styles represented such centres, they, too, should clear.

I consider, therefore, that the so-called latera are really cuticular structures formed by the intermittent growth of the cuticle covering sublateral scales, and that this growth parallels the growth of cuticle on the capitular plates. Whether or not such sublateral styles shall occur depends, I have suggested, on whether the exuvial split in the cuticle occurs below or above the scales. There is another factor, however, which determines whether the styles once formed shall remain or be cut off at their base, and that is the sculpturing of the inner surface of the carina.

In Specimen 3 (Plate I, fig. 2, Text-fig. 2) the inner margin of the carina can be seen produced into beautiful sculptured ridges projecting in a rostral direction. Each ridge, of course, records the outgrowth at the end of a growth-period. Now, at the apex of the carino-tergal angle the lowest ridge projects over the apical scale like a hood. Clearly, then, in this specimen it would not be possible for a sublateral style to occur. The space which should be occupied by the style is already occupied by the inner carinal ridges. And further, if, as I suggested, the exuvial split did pass underneath the apical scale, so that this was carried upwards during the growth period, then at the end of this period, when the ridge grew out from the inner surface of the carina, it would push against and snap off the growing style at its narrowest part.

However, provided the exuvial split occurred in the right place, there is no reason why the scale to the immediate left of the apical scale should not form a style. This, by its upgrowth, would miss the carinal ridges. Although this has not occurred in Specimen 3, there are several specimens in the collection which indicate that this scale and not the apical formed the sublateral style. Thus the single sublateral style which occurs on the right side of Specimen 10 (Plate I, fig. 3) is not an outgrowth of the apical scale, but of the scale next to it on its rostral side. The left side of this same specimen (Plate I, fig. 4) also suggests that here there were originally two styles, one on the apical scale and the other rostral to it, but that these have been broken off by the overhanging carinal ridge. From the photo it can be seen that these are dark and translucent, while the surrounding scales are white and opaque. They are clearly covered with a thicker layer of cuticle than the other peduncular scales.

Specimen 3 is the smallest, and presumably the youngest, in the collection. Its sculptured ridges are more pronounced than in any of the others. This may be a normal variation, but also, I think, it may represent a growth character. As the animals become older so their growth ridges become relatively smaller. If this is so, then in an animal with a tendency to produce sublateral styles, at first, when the carinal ridges are large the apical scale may be unable to form a style, while that rostral to it is free to do so. Later, when the carinal ridges are less marked, the apical scale may find no hindrance in growing into a style. In this case there would be a group of at least two styles, of which the longest would not be the apical, but that rostral to it. This is the condition in specimens 5 and 22 (Table I).

Another factor which determines the occurrence of sublateral styles is simply whether or not there is room for them. If the carina and terga are too close together, then the styles, even if formed, cannot persist. This is probably the normal state of affairs in the tergo-scutal angle, where no styles have ever been recorded. In Specimen 13 (Plate II, fig. 9) the apical scale of this angle can be seen as a narrow triangle projecting up into the tergo-scutal junction. It is probable that at exuviation the split passes underneath this narrow apical scale, but no style is formed, simply because the terga and scuta are always very close together.

There are two abnormal specimens in the collection which, I think, support my suggestion that the position of the exuvial split may vary. In Specimen 15 two cuticular scales were adhering to the capitular cuticle in the lowest groove of the left tergum. Clearly in this case at the last ecdysis the exuvial split had passed round their lower peduncular margins. If they had remained in contact with their underlying centres they would have given rise to styles in this abnormal position. They were, however, only slightly adherent, and came off at once on brushing.

In Specimen 8 (Plate II, fig. 10) a large piece of the girdle covering the tergo-scutal angle has become detached from the cuticle on its peduncular side. The growth of the cuticle on the capitular plates corresponding to its upper margin has been inhibited, possibly due to the tubicolous animal which can be seen in this region. The split along its lower side, however, indicates that at the last ecdysis the exuvial split corresponded with it, but in this case the split must have extended to the deeper layers, including the scale centres.

CIRRI AND MANDIBLES.

The specimens in the collection showed such marked variability in other characters that I did not consider it advisable to dissect more than a few to study the variation in the jointing of the limbs and the pectinations on the mandibles. The results of such a study of four specimens are given in the following table for comparison with Nilsson-Cantell's figures (1921, p. 214) :

Table III.

	Cirri: Number of segments.												Caudal appendages.		Mandible: teeth between cusps.	
	I.		II.		III.		IV.		V.		VI.					
	A.	P.	A.	P.	A.	P.	A.	P.	A.	P.	A.	P.	Right.	Left.	1–2.	2–3.
Specimen 1	9	10	15	17	17	20	21	22	23	22	23	23	12	10	12	7
Specimen 2, left	10	9	13	14	16	17	20	18	20	21	20	12*	10	10	12	7
Specimen 5	9	11	17	17	17	18	20	21	21	23	21	21	9	9	16	6
Specimen 16	7	9	11	16	15	19	20	15*	20	24	21	23	10	10	11	6

* Incomplete.

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DESCRIPTION OF PLATE I.

Lithotrya valentiana.

FIG. 1.—Specimen 11. Typical *Anatifa truncata*, Quoy et Gaimard. × 14.

FIG. 2.—Specimen 3. *L. truncata* according to Darwin. × 7.

FIG. 3.—Specimen 10. Right side—" latera " present. × 7.

FIG. 4.—Specimen 10. Left side—" latera " absent. × 7.

FIG. 5.—Specimen 7. Rostral view showing complete rostrum. × 6·5.

FIG. 6.—Apical views showing varying degree of erosion of capitular plates (*a*) specimen 3, (*b*) specimen 8, (*c*) specimen 11. × 6·5.

FIG. 7.—Isolated valves—from left to right—left scutum and tergum, carina, right tergum, right scutum. (*a*) specimen 5, (*b*) specimen 1 (*c*) specimen 2. × 6.

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DESCRIPTION OF PLATE II.

Lithotrya valentiana.

Fig. 8.—Girdles. (*a*) Carino-tergal angles of specimen 14. × 36. (*b*) Left carino-tergal and tergo-scutal angles of specimen 16. × 36. (*c*) Sub-lateral scales ("latera") of specimen 14. × 100. (*d*) Sub-lateral scales ("latera") of specimen 16. × 100.

Fig. 9.—Specimen 13. Showing sub-lateral scale in tergo-scutal angle, and three chitinous sub-lateral scales ("latera") in carino-tergal angle. × 7.

Fig. 10.—Specimen 8. Showing indications of abnormal exuvial split. × 5.

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PRESENTED

ALCYONARIA

(STOLONIFERA, ALCYONACEA, TELESTACEA AND GORGONACEA)

BY

MRS. L. M. I. MACFADYEN, B.Sc.
(MISS L. M. I. DEAN)

WITH ELEVEN TEXT-FIGURES AND FIVE PLATES

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CONTENTS.

1. INTRODUCTION.

THIS paper gives a systematic report on the Stolonifera, Alcyonacea and Telestacea collected on the Great Barrier Reef Expedition, apart from the Alcyonacean family Xeniidae which has already been reported on by Prof. S. J. Hickson. Three Xeniids, omitted from the material given to Prof. Hickson to describe, are, however, added to this report. The Gorgonacea were also described by Prof. Hickson, but I have to add to this paper two further Gorgonaceans. One of these, *Solenopodium stechei*, as I shall describe later, has had rather a pathetic history, as it was cast out from the Gorgonacea by Prof Hickson, and now is similarly rejected from the Alcyonacea by myself. The two points of view as to the systematic position of this interesting genus are given here by us both.

The collection is a fine one and the specimens are, in most cases, beautifully preserved. Altogether 51 species are described, of which 6 are new. These species are included in 22 genera. Many have been previously reported from the seas of the East Indies and Philippines, the Alcyonarians of which have been described to a considerable extent in recent years, several from Torres Straits and the Western coasts of Australia, and several with a wide distribution, including the Indian Ocean and the Red Sea, with one, the widespread *Tubipora musica*, from the West Indies.

My thanks are due to Dr. Calman for his kindness in giving me the opportunity of working on this interesting collection, to Capt. Totton for all the facilities for examining types, etc., while I have been working in the British Museum (Natural History), to Prof. Hickson and Prof. Cannon for the loan of certain type-specimens, to Prof. Stephenson for his helpful field-notes, and to Dr. Manton for her very fine field photographs.

2. LIST OF SPECIES.

Order STOLONIFERA.

Family Cornulariidae.

Sub-family Clavulariinae.

Clavularia inflata, Schenk, var. *luzoniana*, May.
Sarcodictyon herdmani (Hickson).
Pachyclavularia erecta, Roule.

Family Tubiporidae.

Tubipora musica, L.

Order ALCYONACEA.

Family Xeniidae.

Cespitularia erecta, n. sp.
C. simplex, Thomson and Dean.
C. wisharti, Hickson.

Family Alcyoniidae.

Microspicularia [gen. nov.] *pachyclados* (Klunz.).
Alcyonium australe, n. sp.
Sinularia conferta (Dana), n. var. *gracilis*.
S. dura (Pratt).
S. flexibilis (Q. G.).
S. gardineri (Pratt).
S. gyrosa (Klunz.).
S. leptoclados (Ehrb.).
S. lochmodes, Kolonko.
S. polydactyla (Ehrb.).
S. robusta, n. sp.
Sarcophyton digitatum, Moser.
S. elegans, Moser.
S. glaucum (Q. G.).
S. trocheliophorum, Marenz.
Lobophytum crassum, Marenz.
L. crebriplicatum, Marenz.
L. gazellae, Moser.
L. lighti, Moser.
L. pauciflorum (Ehrb.).
L. pauciflorum var. *validum*, Marenz.

Family Nephthyidae.

Capnella fungiformis, Kük.
C. imbricata (Q. G.).
C. lacertiliensis, n. sp.
C. rugosa, Kük.
Lemnalia brassica (May).
L. elegans (May).
Paralemnalia digitiformis, n. sp.
P. thyrsoides (Ehrb.).
Umbellulifera planoregularis (Burchardt).
Nephthya aurantiaca, Verrill.
N. gracillima, Thomson and Dean.
N. mollis, n. sp.
Dendronephthya bicolor (Wright and Studer).
D. florida (Esper).
D. heterocyathus (Wright and Studer).
D. nigrotincta (Ridley).
D. spinifera, Holm.
Stereonephthya unicolor (Gray).

Family Siphonogorgiidae.

Nephthyigorgia annectens (Thomson and Simpson).

Family Fasciculariidae.

Studeriotes semperi (Studer).

Order TELESTACEA.

Telesto arborea, Wright & Studer.
T. rubra, Hickson.

Order GORGONACEA.

Sub-order SCLERAXONIA.

Family Briareidae.

Solenopodium stechei (Kükenthal).
Iciligorgia orientalis, Ridley.

3. DESCRIPTION OF SPECIES.

Order STOLONIFERA.

This order, established by Prof. S. J. Hickson in 1883, has had a chequered history, with a great amount of confusion amongst the genera originally assigned to it by Prof. Hickson. Latterly several of the genera have been moved by various workers in the group to other orders, and some genera have been found to be synonymous, so that the order

has considerably fewer genera in our present state of knowledge. There is still, however, considerable doubt as to the natural position of certain genera, and as to the validity of others.

There are three genera represented in the Barrier Reef collection which I consider should be placed in the order Stolonifera namely, *Sarcodictyon, Clavularia* and *Pachyclavularia. Sarcodictyon,* according to Kükenthal, is identical with *Evagora,* a genus with which, he states, *Rhizoxenia* is synonymous. I agree with Prof. Hickson (' Proc. Zool. Soc.', Pt. I, 1930, p. 210) that the evidence as to *Sarcodictyon* and *Evagora* is far from conclusive, and in the meantime I retain the genera as distinct. If *Sarcodictyon* is to be suppressed, Molander (' Swed. Antarctic Exp.' II, No. 2, 1929, p. 40) is too general in his statement as the form of spicules, " kleine Gürtelstäbe, gewöhnlichte Sechser oder unregelmässige Kalkkörper, und erinnern an die Spicula bei *Erythropodium caribaeorum* ". The typical spicule of *Sarcodictyon catenata,* Forbes, is a rather scale-like roundish spicule with a frayed edge, and the spicules are very densely packed together. The spicules of *Evagora rosea,* on the other hand, do certainly come near to *Erythropodium caribaeorum.*

Kükenthal (1916), followed by Molander (1929), assigned the genera *Evagora* (and *Sarcodictyon*), *Erythropodium* and *Solenopodium* to the gorgonacean family Briareidae, and later Molander (1929) transferred to it the genus *Pachyclavularia. Sympodium,* one of the most discussed genera, is now generally and rightly, I think, recognized as a Xeniid, and *Parerythropodium* as an Alcyoniid.

I agree with Prof. Hickson that *Sarcodictyon, Evagora, Erythropodium* and *Pachyclavularia* should be retained as Stolonifera and not considered as Gorgonacea. To get so far away in those creeping forms from the definition of the Gorgonacea as having well-defined axes seems to me mistaken, unhelpful to systematists and not a very natural system of classification.

Prof. Hickson and I have a friendly disagreement, however, over the position of the genus *Solenopodium,* of which there is one species in this collection. As Prof. Hickson considers that it, too, is a Stoloniferan genus, he did not include it in his report on the Gorgonacea of the Great Barrier Reef Expedition (1932), but left it to be described with the Alcyonacea. I now in turn reject it, and describe it here as a Gorgonacean. It seems to me impossible to separate *Briareum* and *Solenopodium* ; the spiculation is almost indistinguishable, and *Solenopodium* approaches towards the *Briareum* type of growth. It does not always show a creeping form of growth, but hollow stems grow upwards which are sometimes solid at the tops, forming as it were the beginning of a solid axis. I feel that this genus has definitely crossed the border between the Stolonifera and the Gorgonacea, to the lowest stage of the Scleraxonia. I here quote a note from Prof. Hickson giving his views on the subject :

" The genus *Solenopodium* is of special interest because it seems to be a perfect connecting link between the two orders of Alcyonaria—the Stolonifera and the Gorgonacea.

" The determination of its correct position in one or other of these two Orders depends on the conception of the principal character which should be used to distinguish them.

" In former times the character that was universally used to distinguish the Gorgonacea from other Alcyonaria was the presence of a horny or calcareous axial rod.

" If this character is adopted for the diagnosis of the Order then *Solenopodium* is

not a member of the Gorgonacea because it has no axis, the stems which spring irregularly from the large creeping stolon being hollow.

"In more recent times, however, Kükenthal and his followers have substituted for the presence of an axis the presence of 'horn' in the skeleton as the character of the group and, although there is no evidence that its basal membrane is really 'keratin', *Solenopodium* is placed among the Gorgonacea.

"For many reasons which I have fully discussed in my paper in the 'Proc. Zool. Soc.', 1930, Pt. I, pp. 234–241, the presence of a horn-like skeletal substance is not a good diagnostic character. It occurs in some genera, *e. g.* the Telestidae, which do not belong to Kükenthal's group Gorgonaria, and it does not occur in others (*e. g.* the Coralliidae) which do belong to it.

"It is true that *Solenopodium* does show some resemblances to the Gorgonacean genus *Briareum* and it may indicate a stage in the evolution of the Gorgonacea from the Stolonifera, but as there are no essential differences in other characters, such as in the canal system or the spicules between this genus and other genera of the Stolonifera, I am of opinion that it should be referred to that Order on the ground that it has no horny or calcareous axis."

The genus *Hicksonia*, I am now convinced, must lapse as a synonym of *Clavularia*. As to the genus *Pachyclavularia* I agree with Prof. Hickson and differ from Molander in thinking it a Clavulariid. There is no doubt that it is a form leading towards *Solenopodium* and *Briareum*, but on the other hand, its affinities with *Clavularia* seem to me even greater. I consider the Stolonifera as an order comprising various rather primitive forms which lead to several higher groups—*Pachyclavularia* leading to the Scleraxonians, *Clavularia* leading to the Telestacea and *Anthelia* to the Xeniidae. Molander (1929) includes *Clavularia* with the Telestids, but that I think is stretching the case too far. Roxas (1933) also has not followed him in this, but retains both *Clavularia* and *Anthelia* in the Stolonifera. Prof. Hickson in his report on the Xeniidae of the Barrier Reef Expedition (1931) emphasizes the necessity of suppressing the genus *Anthelia* as a synonym of *Sympodium*, and considers that the species described as *Anthelia* at the moment are Xeniids. I cannot share the opinion that *Anthelia* is the same genus as *Sympodium*; they seem to me quite distinct, both in spiculation and in form of growth. The spicules of *Sympodium* are minute discs typical of *Xenia* species; species of *Anthelia* have minute narrow rods as their spiculation. I have examined many species of *Anthelia* and colonies of *Sympodium coeruleum* and no *Anthelia* shows any sign of contraction, while the polyps in *Sympodium* contract till they are buried in the rather thick basal membrane. As to *Anthelia* itself being a Xeniid, it certainly shows definite affinities with this family. If the presence of only the dorsal mesenteric filaments is confirmed from species other than the one quoted by Prof. Hickson it will be definitely established as a Xeniid.

Family Cornulariidae.

Sub-family Clavulariinae.

Genus *Clavularia*, Quoy and Gaimard.

Cornulariids with polyps united by a basal stolon or basal membrane containing a network of canals. Polyps may also be united by transverse connecting stolons at a varying height up the polyp wall and a new polyp may grow from such a connecting stolon.

Polyps divided into a basal non-retractile calix and a distal anthocodia, which is retractile into the upper half of the calix. The spicules of the calix are long-warted spindles arranged in vertical rows ; the spicules of the anthocodia are always smaller and smoother, sometimes minute and of quite different form. There is definitely a horny secretion in the calix of some species.

Clavularia inflata, Schenck, var. *luzoniana*, May.

Roxas, Philippine Alcyon, Philipp. J. Sci. L, No. 1, 1933, p. 58.

Three colonies of this species all show the rare feature shared by this species and *C. viridis*, namely, the stolons connecting one polyp with the middle of another. We can add nothing further to our previous descriptions—the Great Barrier Reef specimens agree in detail with the type-specimens. The three colonies show polyps in all stages of development and in all stages of expansion ; in all the pinnules of the tentacles are a glistening white owing to the dusting of innumerable minute spicules (rodlets and a few discs) ; the calyx and anthocodia in one colony (Detailed Survey II) are grey-brown with the chevroned spindles of the anthocodia showing up against the brown background ; in another (General Survey, A 71) they are creamy-white, and in another from Maer Island a greenish-grey colour. Prof. Stephenson informs me that the species was very plentiful in some parts of Low Isles, both in the Anchorage and on the seaward slopes ; it sometimes formed extensive continuous carpets. The tentacles during life were purplish or pinkish brown.

LOCALITIES : Maer Island.
Low Isles, General Survey A. 1.
Low Isles, Detailed Survey II.

Previously recorded from Luzon (Philippines), Ternate, Dutch East Indies.

Genus *Sarcodictyon*, Forbes.

Encrusting Cornulariid colonies consisting of narrow stolons, which may form a mesh, with small polyps arising at varying intervals. The polyps are divided into a cone-like calix with hard walls, up to about 2 mm. high, and a distal anthocodia which is soft and is retractile into the calix. The spicules of stolon and calix are usually of flat irregular shape, closely packed together, sometimes with fusion, so that both stolon and calix are hard and inflexible. A horny membrane at the base of the stolon may be present.

Sarcodictyon herdmani (Hickson).

Hickson, Proc. Camb. Phil. Soc., 1921, XX, pt. III, p. 366 ; Proc. Zool. Soc., 1930, p. 210, 1 fig.

A slender pink stolon 2·8 mm. long with small conical calices arising at intervals of 2–3 mm. has grown along a slender Antipatharian twig, which also bears a young colony of *Nephthya aurantiaca*. Prof. Hickson has very kindly sent me for examination his type-specimen of *Sarcodictyon herdmani*, and after a careful comparison of these two specimens I consider that, though the Barrier Reef specimen differs slightly from the type, it comes so near to it that it should be considered as at least a variety of this species.

The calices are in most cases low swellings on the stolon, up to 1·7 mm. broad and with a height of 1 mm. or less. One calix, however, has a height of 1·5 mm. The polyps are white, and in one expanded polyp, though the preservation is not good enough to allow of an exact determination of the arrangement of spicules, there can be seen an armature towards the base of the anthocodia, of slender white spindles, arranged horizontally nearest the calix and longitudinally further up the anthocodia.

Our specimen differs from the type in that, though there is a certain amount of fusion, it is not nearly so extensive as in the Adelaide specimen. Also the irregular type of branched spicule is preponderant in the Barrier Reef form, and the warted spindle type though present, is not so numerous. The same types of spicule are present in both specimens, however, and there does not seem to be sufficient reason to separate the two into different species. There is no question, as Prof. Hickson has stated already, that this species is quite distinct from *S. catenata*.

LOCALITY: Station XII. Dredge.

Previously recorded from South Australia.

Genus *Pachyclavularia*, Roule.

Cornulariids with polyps united basally by stolons or a membrane, which may divide in distinct horizontal lamellae. The polyps consist of a hard-walled tubular calix and a distal soft retractile anthocodia. The typical spicule is the warted spindle.

Pachyclavularia erecta, Roule.

Roule, Rev. Suisse Zool. XVI, 1908, p. 165, 3 figs.; Molander, Swedish Antarctic Exped. II, No. 2, 1929, p. 24; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 19, 8 figs.

A young colony growing on a stone shows the reddish-violet colour, the folded, thick basal membrane, and the stiff-walled, longitudinally-grooved calices, with an average height of 6 mm., all characteristic of the species. In the majority of the polyps the anthocodial portion is fully retracted, but in two or three polyps it is partially expanded. In one polyp an interesting stage of retraction is shown where the anthocodia is expanded beyond the calycine portion of the polyp and the mouth is clearly visible, but the tentacles, which are individually retractile (see Thomson and Dean, 1931), are still invaginated. A field-note included with the specimen, " green polyped ", agrees with Roule's coloured plate of the type, showing brilliant green anthocodia and tentacles, above the red-violet calix. In spirit the green colour of the anthocodia is lost and it is cream-grey in colour. The anthocodia and tentacles under examination proved to be literally packed with a dense mass of zoochlorellae and no spicules were observed.

The spiculation shows large spindles covered with zones of warts and branched, irregular forms. The spicules in the basal membrane are bound together in a horny matrix.

The systematic position of the genus *Pachyclavularia* has already been discussed (see p. 23).

LOCALITY: Wishart's Reef (A. 3).

Previously recorded from Amboina, Dutch East Indies.

Family TUBIPORIDAE.

Genus *Tubipora*, Linnaeus.

Cornulariids distinctive in having very elongated tubular polyps with complete fusion of spicules to form a solid hard mass. Flat horizontal platforms or laminae connect the close-set polyps, and from these platforms new polyps may arise.

Tubipora musica, L.

Hickson and Hiles, Willey's Zool. Results IV, 1900, p. 493.

Three dried colonies, two of which are described as from Low Isles, and one preserved in spirit, from the Outer Barrier, Ribbon Reef. All are a deep crimson-red colour, with the partially expanded polyps showing white in the spirit specimen. Two of the dried colonies and the spirit specimen show a close-set type of growth with adjacent polyps nearly touching each other, the whole colony forming a dense rounded mass. The third dried specimen (overgrown in parts by a Polyzoan) is much more open and less compact, with an average distance between adjacent polyps of 4 mm. This is a good example of the extreme variation possible in the form of colonies of *Tubipora*, in which genus, following Prof. Hickson's view after examination by him of very numerous specimens in Celebes and from elsewhere, we find only one species, *T. musica*.

LOCALITIES : Low Isles, outside Anchorage, 6 fathoms.

Outer Barrier, Ribbon Reef, Middle Zones.

Previously recorded from Red Sea, Indian Ocean, West Indies, tropical Pacific Ocean, Dutch East Indies.

Order ALCYONACEA.

Family XENIIDAE.

Genus *Cespitularia*, Milne-Edwards.

Xeniids with dendritic branching, and no sharply-defined margin to the capitulum, the polyps arising not only on the summit of the branches, but in gradually diminishing numbers down their sides. Colonies typically soft, and with weak or no spiculation. The spicules, if present, are small discs, irregular ovals, or biscuit-shaped.

Cespitularia erecta, n. sp. (Plate IV, fig. 7.)

Two small colonies from Station XXIII cannot be referred to any of the described species. They differ from *C. taeniata*, *C. coerulea*, *C. wisharti*, *C. hypotentaculata* and *C. quadriserta* (the last two recently described by Roxas, 1933) in the presence of spicules ; from *C. simplex*, *C. mollis* and *C. mantoni* in the size and shape of the spicules and in the mode of growth ; from *C. multipinnata* in the arrangement of pinnules and mode of growth ; and from *C. subviridis* in the size of polyps and number of pinnules.

The largest of the two colonies has a height of 3·5 cm. and a maximum spread of 1·8 cm. A short stem, 9 mm. in maximum diameter, gives rise to 4 short branches and a terminal branch. The longest branch has a length of 1·4 cm. and a diameter of 5 mm. and 3 mm. The stem is only slightly flattened, as are the other branches, which give rise

to 2 or 3 very short twigs. The branches are covered with the short stout polyps, which reach a length of 2 mm. and with tentacles up to 2·6 mm. long. The pinnules are arranged in a single row of 18–20 on each side of the tentacle; they are longest towards the middle of the tentacle, where they are up to 0·4 mm. in length with a basal breadth of 0·1 mm. They are finger-like and pointed when expanded. A few rudimentary buds of polyps are to be seen on the stem.

The whole tissue of the colony is filled with a dense mass of small spicules. These are either roughly circular, or oval, or with definite corners, so that little polygons or squares are seen. They are smooth and refractive without the surface sculpturing seen in *C. simplex*, and they are neither nearly as large nor with as smoothly circular outlines as in *C. mantoni*, and are much more numerous than in the latter species. They attain a diameter of 0·045 mm.

The colony is quite firm in texture and stands erect. It is cream white in colour.

The smaller, almost circular colony with a height of 2·4 cm. and a maximum diameter of 2·2 cm. has a flat base, almost membranous, from which arise 5 close-set main branches which give off 1 to 4 short branches. It agrees exactly with the first specimen in all other characters.

LOCALITY: Station XXIII. Dredge.

Cespitularia simplex, Thomson and Dean.

Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 33, 1 fig.

A small colony from Station X agrees well both in form of growth and in spiculation with the type of the species. It shows a membranous base (which creeps over two pieces of rock and connects the two mid-way), from which arise the very simple stems, which are either finger-like and unbranched or else very simply branched. In this case 7 of the stems are unbranched and one gives off one small twig 4 mm. long. The longest unbranched stem has a height of about 1·5 cm. and a breadth of 4 mm.

Another distinctive feature is the spiculation, which consists of extremely numerous, very minute discs, seen to be finely sculptured under a high magnification and about 0·01 mm. in diameter.

The colour is creamy, streaked with extraneous staining of red from some debris.

LOCALITY: Station X. Dredge.

Previously recorded from Kawassang, Dutch East Indies.

Cespitularia wisharti, Hickson.

Hickson, The Xeniidae, Sci. Rep. Great Barrier Reef Exped. IV, No. 5, 1931, p. 165, 1 fig.

A small yellowish colony, not very well preserved, from Station XXIII shows 6 unbranched or slightly branched stems arising from a ribbon-like base. The polyps are, for the most part, 1–2 mm. long, but 3 to 4 extended ones are 3 mm. long. The tentacles are about 1·8 mm. long, and have a single row of about 15 pinnules on each side of the mid-line. (In the type-specimen in a fully expanded tentacle I found the pinnules stretched into a single row of 18 on each side of the tentacle.) There are no spicules.

A very contracted colony from Low Isles is most remarkable in the development of numerous sucker-like outgrowths with oval attaching discs. Some of the branches terminate in a fringe of these or they may grow out from the side of a branch. I have

seen the development of a sucker in *C. simplex* (see "Siboga" Exped., 1931, p. 34), but this great development of these attaching outgrowths is extremely unusual. The longest of these outgrowths is strap-like, with a length of 1·4 cm. and a breadth of 1·5 mm. and forming at the extreme tip into two small oval suckers. The polyp tentacles are in the majority of the polyps contracted to a minute length, 0·1 mm. or less, so that with the naked eye the polyp appears like a small tube without tentacles. The pinnules on these minute tentacles are very difficult to detect. In some of the polyps the tentacles are about 1 mm. long with 8–12 pinnules. The length of the polyps themselves is also most variable, but an average one is about 2 mm. long.

The form of growth is also curious, as the base grows in a complete circle round a space in the middle. Both the base and the stems which arise from it are flattened, though some of the short upper branches into which the stems divide are quite rounded. The branching is very variable. Some stems arise unbranched from the base, while others may give off up to five short branches, 5 mm. long, which may again fork 5 mm. from the tip. There are no spicules.

I have compared this specimen carefully with the type of *C. wisharti*, and have no doubt that it is a very contracted specimen of the species, with sucker development owing no doubt to special environmental conditions. The colour is brownish grey.

Another difficult specimen, from Station XVI, also with no spicules, does not show any sucker development, but does show the same extreme contraction and apparent reduction of the tentacles in some of the polyps, while in others they are quite well developed up to about 1·5 mm. The polyps, which are not abnormally expanded, are about 2 mm. long, but some of them are extended till they are quite transparent and up to 5 or 6 mm. long and 2 mm. broad when flattened out. Very few of the tentacles, however, show great expansion. The longest were 1·5 mm. long, with a single row of 12 pinnules on each side of the middle line. The branches are more or less circular. The colour is a purplish grey. The colony is spread out over a conglomerate mass of shells, stems and debris.

Localities : Station XXIII. Dredge.
Station XVI. Dredge.
Low Isles, September–October, 1928.
Previously described from Great Barrier Reef.

Genus *Microspicularia*, n. gen.

In 1931 Sir J. A. Thomson and I emphasized the advisability of separating off from the genus *Alcyonium* those *Alcyonium*-like forms (*e. g. A. sphaerophora*) which have a very distinctive spiculation (numerous very small double-clubs or dumb-bells, together with very typical minute hour-glass-like or finger-biscuit-like forms), and a form of growth with very flat shallow basal trunk bearing numerous relatively simple and compacted lobes. Unfortunately we made a mistake in trying to refer these to the old genus *Lobularia*, which I now see is a synonym of *Alcyonium*. (The original *Lobularia* species was *L. digitata*, which of course is an *Alcyonium*.) The genus *Lobularia* must go, but there is still the necessity to separate off certain species mistakenly and persistently referred to *Alcyonium*, and I refer the species concerned to the new genus *Microspicularia*, so named from the minute size of the spicules, especially in the polyps. In addition to the features

already mentioned, another distinctive feature which has been ignored by those workers who strung the two genera together in one is the fact that in true *Alcyonium* spp., *e. g. A. digitatum. A. palmatum, A. etheridgei, A. brionense*, etc., the armature of the retractile polyps consists of long, narrow spindles arranged in 8 points beneath the tentacles. The armature is always in this form if present at all. This type of armature is also found in *Metalcyonium* species. Now in the *Microspicularia* species (to be enumerated later), polyp armature consists of a dense, irregularly set mass of extremely minute finger-biscuit-like forms or derivatives of these with absolutely no chevron arrangement, and completely covering the whole anthocodia and tentacles of the polyp. I cannot see that this, in conjunction with the consistently shallow, much-lobed form of growth and the typical minuteness of the dumb-bell spicules, together with the presence of biscuit-like forms, is not sufficient evidence to warrant the validity of the genus *Microspicularia*. I follow the late Sir J. A. Thomson in thinking that from a genus as cumbrous as *Alcyonium* and with such varied types as are grouped together by Lüttschwager in his Revision of the genus *Alcyonium* (1915 and 1926), also by Roxas (1933), the separating off of a distinct group of species would be, in addition, of very great help to the systematist.

The genus *Microspicularia*, then, would include the following six species : *M. sphaerophora* (Ehrb.), *M. globuliferum* (Klz.), *M. digitulatum* (Klz.), *M. pachyclados* (Klz.), *M. brachyclados* (Ehrb.), and *M. globuliferoides* (Thomson and Dean).

Alcyonium ceylonicum, Pratt, is a true *Alcyonium* and not a *Microspicularia* (see Thomson and Dean, 1931). Though the spicules resemble the double clubs of a *Microspicularia* more than any other species of *Alcyonium*, they are considerably larger and heavier than in the *Microspicularias*, and, more important, there are none of the small hour-glass-like spicules. Lüttschwager considers this species a synonym of May's *Alcyonium ceylonense*. I have had the opportunity of examining a specimen from Galle, Ceylon, which agrees very closely with Miss Pratt's original description of this Ceylon species, and another superficially very similar specimen from the same locality, with siphonozooids extremely minute and difficult to detect, which is a species of *Lobophytum*, and which I think may be a specimen of May's *Alcyonium ceylonense* as the spiculation and growth seem identical. Even if May's species is a true *Alcyonium* and not a *Lobophytum*, as I suspect, I do not agree with Lüttschwager that *A. ceylonicum* is synonymous with *A. ceylonense*, as the spiculation does not agree—there are none of the clubs described by May, and the tuberculate dumb-bells are about half the size of those in *A. ceylonense*.

A summary of the features of the genus *Microspicularia* is as follows :

Alcyoniid of stout type of growth, with a very short broad, rather encrusting base and a disc densely set with very numerous small thick, compacted lobes. Spiculation exclusively of very small dumb-bell or double-club spicules and minute hour-glass or finger-biscuit-like forms. Polyp armature consists of a dense, irregularly-set mass of the minute hour-glass spicules. Genotype, *Alcyonium pachyclados*, Klunz.

Microspicularia pachyclados (Klunz.). (Plate III, fig. 2.)

Klunzinger, Korallthiere des Rothen Meeres, 1877, pt. 1, p. 24, 1 fig. ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 40 ; Lüttschwager, Arch. Naturgesch. Berlin, LXXX, Abt. A, Heft 10, p. 20.

This well-known species is represented in the collection from the Great Barrier Reef by several fine specimens.

A grey-white colony from Maer Island, with most of the polyps contracted, a few semi-expanded, has diameters of 10·6 × 9 cm. and a maximum height of 6·5 cm., the average height of the basal stock being 2·5 cm. The blunt finger-like lobes are not compressed to such an extent as in a species such as *M. sphaerophora*.

Other smaller specimens from Low Isles have well-expanded polyps. The largest of these colonies has diameters of 6·5 and 4 cm., and a maximum height of 3·8 cm.

The spiculation agrees fully with Klunzinger's description. The maximum size of the large spinose double-spheres measured is 0·1 mm. (Klunzinger quoted 0·096 as the maximum in his specimen, and Thomson and Dean 0·08 mm. in one specimen to 0·1 in another.)

A small specimen (Low Isles), with a height of 1·7 cm. and maximum diameters of 2·7 cm. and 3·4 cm., and another, a very similar one (Detailed Survey 1), with a height of 2·3 cm. and diameters of 4·6 cm. and 3 cm., are more grey in colour with brownish tentacles, the texture is rather harder and the lobes are divided up into rather smaller lobes than in the more typical specimens. The spiculation is identical, however, and I could detect no difference in the structure of the tentacles.

Another small colony (General Survey, 20th May, 1929) with a height of 2 cm. and diameters of 4·5 cm. and 2·7 cm. is white, with the fully retracted polyps showing as dark spots on the surface. In this, too, the lobes are somewhat harder and smaller than is common in the species. There do not seem to be sufficient grounds, however, for making this a new species. The shape and size of the dumb-bell spicules are identical with those of *M. pachyclados*. The only difference in the spiculation is in the tentacles, which are very sparsely dotted with a few of the minute finger-biscuit or hour-glass forms instead of being densely covered with them. It is this lack of the dusting of refractive spicules in the polyps which gives the dark-spotted look to the colony. The uneven distribution of those small spicules present on the tentacles, however, leads me to think that there has been some acid or other interference with them—some of the polyps show a complete absence of them, others show one or two at the tip of each pinnule, and others show one or two pinnules quite thickly covered with them.

Localities : General Survey of Low Isles.
Detailed Survey I of Low Isles.

Only localities stated : Maer Island, North-West Reef Flat ; but Prof. Stephenson notes that this species was common in the anchorage and on the seaward slopes at Low Isles, and easily recognized.

Very wide previous record from Red Sea, Dutch East Indies, West Australia, etc.

Genus *Alcyonium*, Linnaeus.

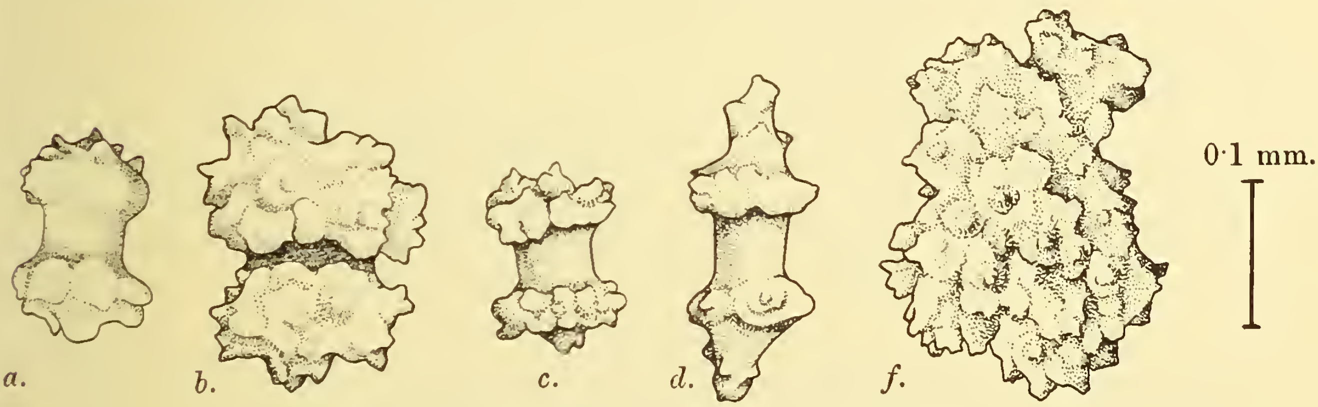
Alcyoniids whose colonies are either massive, with a stalk and a disc divided into lobes (*Eualcyonium*), or columnar and unbranched (*Metalcyonium*). The polyps are monomorphic, located on outer surface of the colony and completely retractile. The polyp-armature, if present, includes vertical or chevroned rows of spindles. The canal system is very irregular.

Alcyonium is easily distinguished from *Sinularia* by the absence of very large stem spindles and the dense outer layer of clubs found in *Sinularia*. From *Microspicularia* it is also easily distinguished by the absence of the small hour-glass-like forms typical of

Microspicularia, and by the armature of the polyp, the polyp of *Microspicularia* being a dense, irregularly-set mass of minute finger-biscuit-like forms. Dumb-bell spicules when present are always larger than the very small *Microspicularia* spicules.

Alcyonium australe, n. sp. (Plate IV, fig. 4.)

A colony from Maer Island, N.W. Reef Flat, adds a new species to the already long list in this genus. It is, however, quite distinctive, approaching nearest in spiculation to *A. ceylonicum*, Pratt, and *A. etheridgei*, Thomson and Mackinnon, but distinguished from them by a very different form of growth and by less numerous polyps than in *A. ceylonicum*, and much smaller and more closely-set polyps than in *A. etheridgei*. The colony has a broad, flat sterile stem, with an average height of 1·8 cm. At the base membranous extensions of the stem wrap round a piece of madrepore, and at one side for a short distance the stem is 2·3 cm. high. The surface of the stem is unwrinkled, slightly harsh to the



TEXT-FIG. 1.—*Alcyonium australe*, n. sp. Spicules.

touch. Its more or less flat surface bears a much-lobed capitulum covered with polyps. Some of the lobes are small, simple, rounded at the tips, from 3 mm. to 1·5 cm. high, and from about 3 mm. to 9 mm. broad. But there are, in addition, flattened broad ridges, which divide in the upper half into secondary lobes, finger-like and rounded at the tips. One such fold has a height of 2·8 cm., a breadth of 3 cm. and a thickness of about 6 mm. It divides at the top into five finger-like lobes closely adjacent, which increase in length in order from 4 mm. on one outer side to 1·5 cm., the outer one on the other side being slightly broader and shorter (1·2 cm. long). The whole ridge has, indeed, a faint resemblance to the palm, fingers and thumb of a hand. Some other ridges are also flattened and lobed, but there are other compound lobes which are rounded and give off secondary lobes in a more irregular manner. Most of the lobes and ridges do not grow upright on the stem, but slope markedly to one side, pressing down on each other and making the whole colony flatter and more compact. This flattening is not probably typical, however, and may be due entirely to environmental factors.

The polyps are very small, on an average about 10 or 11 to a centimetre. None are fully expanded, but the very short tentacles could be seen to have no spicules, though it was impossible to determine the number or arrangement of pinnules. The apertures in the coenenchyma when the polyp is retracted can be seen quite easily by the naked eye. They have a diameter of about 0·75 mm.

The colourless spicules are very uniform. They are nearly all tuberculate dumb-bells or derivatives of these, closely resembling both in form and size those of *A. ceylonicum.* The most common type is (*a*) dumb-bells with two terminal clusters of compound warts with a quite distinct median waist. Average dimensions are 0·17 × 0·11 mm. (*b*) In some the waist portion is much shorter, merely a slit between the two tuberculate heads, so that an almost spherical type results. Young simpler forms of (*a*) and (*b*) are there in all stages. (*c*) In some instead of two terminal clusters of warts there are two definite zones of warts near the ends which actually terminate in a distinct separate cluster of warts. (*d*) More elongated forms of this type, but with the ends more pointed, so that a spindle with two zones of warts results. These are up to 0·2 × 0·1 mm. in size. (*e*) A few very warty quadriradiate derivatives of the dumb-bell type, often with two arms more developed. (*f*) A few more massive and extremely warty irregular spheres, up to 0·22 mm. in diameter. The canal walls are filled with spicules, but there is quite a definite space between individual spicules, and they are not packed as closely as in the cortex, where they lie in a dense mass. The texture of the colony is firm and hard, only slightly fleshy. The colour is a very light greenish-grey.

LOCALITY : Maer Island. N.W. Reef Flat.

I take this opportunity of stating that Wright and Studer's (1889) two species of *Alcyonium, A. haddoni* and *A. sollasi,* the types of which I have examined in the British Museum, are unquestionably true species of *Alcyonium* and not of *Sinularia,* as Lüttschwager thought might be possible (' Phil. Journ. Sci.' XX, 1922, p. 538).

Genus *Sinularia*, May.

Alcyoniids where the capitulum is not a definite disc delimited from a sterile stalk. The zooids are borne on finger-like or lobe-like processes. Siphonozooids are indistinguishable on the outer surface ; if present they are completely rudimentary. In the stalk, the cortical spicules are small clubs forming a dense outer layer ; the inner spicules are very large warted spindles up to 1 cm. long, with the warts not arranged in zones as in *Lobophytum.*

Sinularia conferta (Dana), n. var. *gracilis.* (Plate II, fig. 1.)

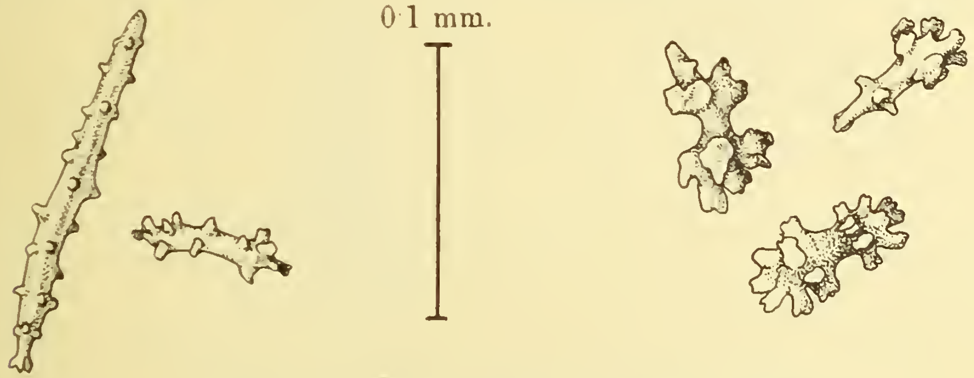
Kolonko, Die Gattung *Sinularia,* Mitt. Zool. Mus. Berlin, XII, 1926, p. 313.

With some hesitation I refer to this species a specimen from Low Isles. It is 10 cm. in height with a maximum spread of 3·5 cm. The stem, which is torn on both sides, is rather flattened (partly owing to the tears), with cross-diameters of 2·3 cm. and 1 cm. Branches arise irregularly from its surface ; in this torn specimen the first branch arises 3·4 cm. from the base, but others may have arisen lower down in its complete state. The branches may have either only secondary branches, or may divide near their base into secondary branches which give rise to small tertiary twigs. The stouter branches have a diameter up to 1 cm. before they fork ; the twigs vary in length from short lobes, 2 mm. long up to about 1 cm. long and a diameter of about 2–3 mm. One very slender branch which arises at the lowest branching level is 2·3 cm. long, with a diameter of 1–3 mm. Some of the twigs have blunt tips, but the majority narrow towards the tip.

The colour is a dark grey-brown with the contracted polyps showing up as darker specks. The polyps are, on an average, about 1 mm. apart. The surface is very slightly

gritty, much smoother than in most *Sinularia* species. the texture of the twigs and branches is like indiarubber, and that of the stem, which is densely filled with large spicules, is hard.

The spicules include (*a*) small clubs of the rind, which are very varied in shape. The heads may have a central wart with a ring of warts below this (this is the most common type), or the central wart may be forked into two, or the head may consist of a mass of small blunt warts grouped closely together. The heads are large in proportion to the length. *e. g.* a club 0·09 mm. long may have a head 0·05 mm. across. The stems of the clubs have simple prominences. The clubs vary in length from 0·06 mm. (with a head of 0·04 mm. across) up to 0·17 mm. long. The majority have a length of about 0·1 mm. The maximum breadth of head is 0·06 mm. (*b*) Straight or slightly curved spindles or



TEXT-FIG. 2.—*Sinularia conferta* var. *gracilis*. Spicules.

rods covered with some fine blunt thorns, or almost smooth, 0·15 mm.–0·4 mm. long and 0·015 mm.–0·04 mm. in breadth. (*c*) Heavy spindles for the most part with pointed ends, some rather blunt-ended covered with compound warts or simple thorns. These are up to 2·5 mm. in length, and 0·45 mm. in breadth including the warts. These spindles are densely packed in the stem.

In some ways this variety approaches *S. flexibilis*. The smooth rubber-like texture and shape of the twigs and the length of some are comparable to a contracted specimen of that species, but the mode of branching is different and the twigs have not nearly the same power of expansion. Dr. Manton states that in the living state they were clearly different species. Dr. Stephenson's field-notes state that the species was not common.

LOCALITY : Low Isles.

Sinularia dura (Pratt).

Pratt, Alcyonaria of the Maldives, 1903, p. 528, 4 figs. ; Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 304 ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 50.

This species, one of the most easily distinguished of *Sinularia* species, is characterized by a very hard texture, the spicules of the stem being up to 7 mm. long and the clubs of cortex being unusually large, with a head measurement of up to 0·1 mm. across and with the characteristic shape figured by Miss Pratt. It shows curiously two modes of growth, both types having been recorded both by Miss Pratt and by Thomson and Dean. The capitulum may either be a simple cup-shape, or from the surface of the cup-shaped or flattish capitulum numerous lobes may grow. The Barrier Reef specimen is of this latter

type. The surface of the capitulum is rather cup-shaped, flatter towards one side, and from the surface arise stiff, hard branches, which give rise to secondary and tertiary branching. All the characters of texture and spiculation are thoroughly typical.

The height of the colony is 5 cm. It is broken along one side, so is triangular in shape, with a maximum spread of 7·4 cm. The longest upright branch is 1·9 cm. high. The polyps are numerous on the twigs, but very sparsely scattered towards the flat centre of the capitulum.

The colour of the colony is a dark cream.

Locality : General Survey of Low Isles, A. 5 or area between Anchorage and Mangrove Swamp.

Previously recorded from Ceylon, Red Sea, Maldives, Dutch East Indies.

Sinularia flexibilis (Q. G.).

Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 310, 1 fig. ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 53, 2 figs.

Two specimens of this distinctive and easily recognized species from Three Isles and Low Isles show its unusually long thin flexible branches (covered with polyps) which grow from the upper surface of the stout sterile stalk. The spiculation of the branches is very weak, consisting of only a few scattered small clubs, but the stem is densely packed with the heavy spindles common to *Sinularia* stems and with the rind filled with a dense mass of clubs. The stem spindles are small compared with some species of *Sinularia*, with a maximum length of about 2 mm. The warts covering their surface are characteristically large, with a diameter of up to 0·05 mm. The small clubs are very irregular in shape, but almost all have a very large, rounded head covered with low warts, and a very short stem.

The largest specimen from Low Isles has a height of 10·2 cm. and a maximum stem diameter of 5·4 cm. The longest unbranched twig has a length of 3·3 cm. and a basal diameter of 5 mm. The polyps are all semi-expanded, which increases the diameter of the twigs. The colour is creamy.

A second specimen from Three Isles with a height of 9·7 cm. and a stem diameter of 3 cm. is superficially different in appearance in the preserved state, as all the polyps are fully contracted and the surface of the contracted twigs is smooth and rubbery. It agrees, however, fully with all the characters of the species. The colour is a rather greenish-grey, lighter in the stem. Neither of the specimens show branches or twigs quite as long and slender as are found in the species, and round the edge of the capitulum the branches are very short and undeveloped.

Dr. Stephenson, in his field-notes, remarks : " Common. Makes large fields of waving, soft, light brown tail-like branches.".

Localities : General Survey of Low Isles, A. 4.

Three Isles, A. 2.

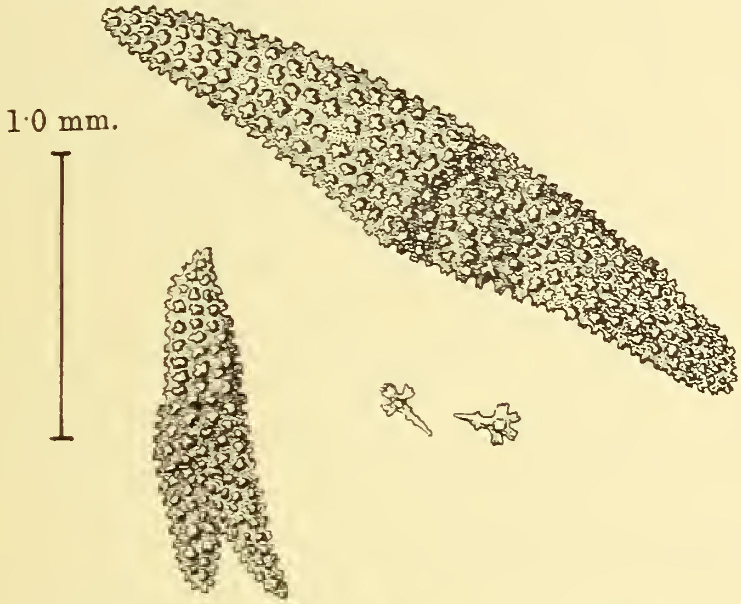
Previously recorded from Amboina, Samoa, Fiji Islands, Dutch East Indies, etc.

Sinularia gardineri, Pratt. (Plate V, fig. 2.)

Pratt, Alcyonaria of the Maldives, 1903, p. 527, 1 fig.

This species was regarded as doubtful by Lüttschwager (' Arch. Naturg.', Abt. A, Heft 10, 1914, p. 14), followed by Kolonko (' Mitt. Zool. Mus. Berlin ', XII, Heft 2, 1926,

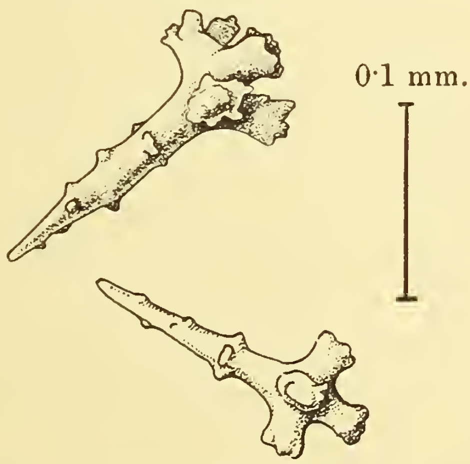
p. 333). Thanks to the courtesy of Prof. Cannon, who has sent me various specimens and types, I have been able to examine one of the Ceylon specimens identified by the author of the species. It seems to me to be unquestionably a distinct species, differing quite



TEXT-FIG. 3.—*Sinularia gardineri*, Pratt. Spicules.

decidedly from any other described species. Two colonies from the Barrier Reef collection agree well with the Ceylon specimen both in the manner of lobing, the size and number of the zooids, and in the rather distinctive spiculation.

A flat, low-growing colony from Low Isles, with a spread of 6 × 3·4 cm. and a height



TEXT-FIG. 4.—*Sinularia gardineri*, Pratt. Cortical clubs.

of 3·9 cm., has a low irregular stalk which slopes outwards to the edge of the capitulum, on whose flat surface are a large number of rather low, close-set lobes, which arise around the edge and from the centre. Each main lobe is much subdivided, so that at its tip there may be up to 6 or more very blunt-tipped secondary lobes. The average length of these is about 5 mm., and the highest lobe, including main and secondary lobes, is 1·5 cm. The

colour is creamy, and the texture is very hard and brittle. The autozooids are fully retracted and very inconspicuous ; they are small and numerous, up to 1 mm. apart. No siphonozooids can be seen.

The spicules include the usual cortical clubs, and from the coenenchyma large, especially heavily warted spindles, up to 3 mm. or a fraction more in length. The cortical clubs are rather distinctive, being exceptionally heavy and coarse, though not as large as those of *S. dura*. The majority of them are short and stout, 0·15 × 0·07 mm., 0·22 × 0·09 mm., with a central compound wart at the tip of the head and four large ones projecting at right angles to these. They are of the type, but rather coarser and shorter, with a stouter shaft, of *S. polydactyla*, from which species, however, they are distinct. Some of the larger clubs especially have irregularly warted heads. The maximum length of club measured was 0·24 mm.

In a second flat colony, grey-cream in colour, also from Low Isles, the stem slopes outwards to the capitulum, which projects beyond it. The low, close-set lobes covering the capitulum are very blunt-tipped. They are rather shrivelled in this specimen, some are rounded, some rather flattened. The details of texture, zooids and spiculation are the same as in the first specimen. Some of the large spindles are bifurcate.

Locality : Low Isles.

Previously recorded from Maldives, Sudan, Red Sea.

Sinularia gyrosa (Klunz.).

Klunzinger, Korallthiere des Rothen Meeres, I, 1877, p. 27, 1 fig. ; Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 329.

Three colonies, two of which are from Maer Island, the third from Low Isles, are referable to this species. All show a low flat type of growth and a capitulum covered with polyp-covered wall-like folds, which twist and curve over the surface. The two colonies from Maer Island, both incomplete, are greenish-grey-yellow in colour, and overgrown with a sponge. They resemble each other so closely that they might be part of one colony. The larger fragment has a length of 8 cm., a breadth of 4·8 cm. and a height of 3 cm. The stem is 1·4 cm. high. Above this the edge of the capitulum projects in a definite ledge. The contours of the folds are somewhat masked by the growth of the epizoitic sponge ; in the second colony they reach a height of 1·8 cm. The texture of the colony is very hard, almost stone-like. The large, densely-packed spicules of the stem are up to 4 mm. in length, rather blunt-ended rods or ovals. A few are pointed spindles. The clubs have heads with a central compound wart and frequently 2 or more lateral warts, which are fairly long and projecting. The normal length of the clubs is 0·1–0·15 mm., but they may reach a length of 0·25 mm.

The third colony, from Low Isles, is a fine specimen, very striking in its mode of growth. It shows the same flat encrusting form, but it would seem to have been cut through near the base, so that the actual edge of the capitulum is not seen. It is almost circular in shape, and in the middle is a complete hollow core, rather triangular in horizontal section, passing through the colony. The folds of the capitulum radiate outwards from this central space. The wall-like folds of the capitulum appear more sharp and clear-cut in this specimen, as there is no overgrowth of sponge. The colour is a clearer cream-colour, but the texture is also hard and stony. The spiculation is the same, save that the size

of the densely-packed inner sclerites is rather smaller, the maximum length being 2·2 cm. The maximum diameter of the colony is 13 cm., the height 5·3 cm., and the maximum diameter of the central hollow core 1·9 cm.

I do not consider that either the rather reduced size of the stem spicules or the unusual shape of the colony are likely to be of varietal value, but that they are probably more due to environmental factors.

LOCALITIES : Maer Island, N.W. Reef Flat. 11th May, 1929.

Low Isles. Boulder outside rampart, at south of island. General Survey.

Previously recorded from Red Sea and Pelew Island.

Sinularia leptoclados (Ehrb.).

Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 305, 1 fig.

A small greenish-grey specimen stands 5·2 cm. in height and has a maximum spread of 4·3 cm. Slender rather knotted finger-like branches and branchlets up to 1·4 cm. long, with a diameter of 4 mm., arise from near the base of the stem. The texture is rather hard. The spiculation, in addition to long spindles, shows small cortical clubs of a shape typical of the species, 0·05 mm. and more in length, with a small head (as figured by Klunzinger and Burchardt; for references see Kolonko, 1926), consisting of a number of closely opposed simple warts.

LOCALITY : Low Isles.

Previously recorded from Ceylon, Amboina, Port Denison (West Australia), Philippines, Dutch East Indies, Red Sea.

Sinularia lochmodes, Kolonko. (Plate II, fig. 2.)

Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 300, 3 figs.

Six colonies of this distinctive species show their surface characteristically covered with very numerous short finger-like or knob-like branches. They agree closely with Kolonko's description and figures of the types. A field-note by Prof. Stephenson states : "A finely-branched species—the branches very extensile during life. Common." The texture is hard. The largest specimen, yellow brown in colour, from Reef A, has a height of 11 cm. and a maximum breadth of 6·3 cm. The sterile stem viewed from one side is 3 cm. high and from the other side 3·5 cm. high. Above this arises a thick stock, maintaining almost the same diameter throughout, thickly covered with a mass of very short branches, the majority of which do not divide, but remain as short outgrowths from low knob-like swellings up to 6 mm. in length.

This species undoubtedly comes near to the type of *S. leptoclados* (Ehrb.), but the branching is much finer and the spiculation shows a distinct difference in the shape and size of the small clubs. None of these are as small as the minimum 0·05 mm. in *S. leptoclados*. The smallest are 0·07 mm. in length. The head though, as in *S. leptoclados* without a central wart, has fewer and more widely separated and distinct, blunt warts, and is generally much more irregular in form.

A brown colony, 7 cm. in height, shows longer fine branchlets, probably in a greater state of expansion. They are up to 11 mm. long, only sometimes 2·5 mm. in diameter. The spiculation is identical.

Of three other fairly contracted small colonies, two are cream coloured, the others grey brown.

Two colonies from Low Isles show a rather more uniformly stout branching, though a few of the low rather wart-like branches are present. The spiculation is identical, with the other specimens of this species. The larger of the two, with a height of 7·3 cm. and a spread of 6·5 cm., yellowish in colour, has twigs up to 15 mm. long, with a diameter of 5 mm. It bears a superficial resemblance to *S. polydactyla*, but there is no question that it is a more coarsely branched variety of *S. lochmodes*. The smaller dark brown colony shows a similar coarser branching, but exactly similar spiculation.

LOCALITIES : Reef A, Lizard Island.
Low Isles, Detailed Survey II, Yard 113.
Five from Low Isles.

Previously recorded from Mindoro and Palawan.

Sinularia polydactyla (Ehrb.). (Plate I, figs. 1–3 ; Plate V, fig. 4.)

Kolonko, Die Gattung *Sinularia*, Mitt. Zool. Mus. Berlin, XII, 1926, p. 319, 2 figs.

Ten specimens show the variability in growth and to a certain extent in spiculation commonly found in this species. All the specimens are densely lobed with varying lengths of finger-like lappets, and in all the spiculation shows the very long pointed spindles, and the clubs with a head showing a central wart and a zone of lateral warts, characteristic of the species. This species has been previously described in such detail that a full description of each specimen here would seem to be unnecessary. A field-note by Prof. Stephenson states : "Common species, growing to large size, brown or grey in colour, with stout lobes."

TEXT-FIG. 5.—*Sinularia polydactyla*. Cortical clubs.

Somewhat doubtfully I include along with these specimens two small flattened colonies from Station XXIV, which grow in one plane. The type of growth with finger-like branches and also the spiculation are within the limits of the species, but the growth in one plane is rather distinctive and the specimens are unusually hard and brittle in texture. I do not, however, feel justified in creating a new species or a new variety on such slender grounds. The larger colony has a height of 7·4 cm., a capitulum spread of 4 × 1·2, cm., and a stem 4·4 cm. high with cross diameters of 9 mm. and 2·1 cm. The stem splits into two main branches, which give rise to slender, very slightly flattened, finger-like lobes up to 1·2 cm. long with a diameter of about 3·5 mm. The autozooids (no siphonozooids can be seen) are semi-expanded, set $\frac{1}{2}$ mm. to 1 mm. apart. The spicules

include warted spindles up to 5 mm. long, and cortical clubs which have, for the most part, a head with central wart, and beneath that a zone of warts projecting more or less at right angles. Some of the club-heads are simply a mass of irregularly-placed or radiatory warts. The stems of the clubs vary in length from short, stout, rather blunt-ended rods, 0·06 mm. or less in length, to long slender-pointed axes, 0·23 mm. long. The stoutness of the clubs varies very much; a club 0·2 mm. long may have a head from 0·04–0·08 mm. across and a stem from 0·02 to even 0·05 mm. across, near the head. The colour is cream, stained with brown.

The smaller colony has no striking differences. It has the same flattened, digitate type of growth, hard, brittle texture, and is creamy in colour.

Another rather doubtful specimen (Plate V, fig. 4) from Low Isles seems to me referable to *S. polydactyla*, though the mode of growth differs somewhat from the usual. The branches come off right to the base of the main stock, which also is covered with polyps to the base. Spiculation, however, and the texture and shape of the lobes are quite within the limits of this species. The club-heads of the rind have, for the most part, a central wart, with a ring of lower warts; the large-warted spindles of the stem reach a length of 3·5 mm.

The height of the colony is 7·5 cm., with maximum cross diameters of 5·9 cm. and 4·2 cm. The branches may give off short, stout, secondary and tertiary blunt twigs or lobes, or may arise from the stock unbranched and with a length of up to 1·7 cm., with a basal diameter of 6 mm. narrowing slightly to the tip.

The texture is fairly hard and firm, with a gritty surface. The colour is a greenish cream.

Localities: General Survey, Low Isles, A. 5. 11th April, 1929 (3 specimens).
Low Isles, Detailed Survey I. Outside Rampart.
,, ,, ,, II, 23rd April, 1929.
Station XXIV. Dredge (2 specimens).
Low Isles (4 specimens).
Very wide distribution (for full details see Kolonko, 1926).

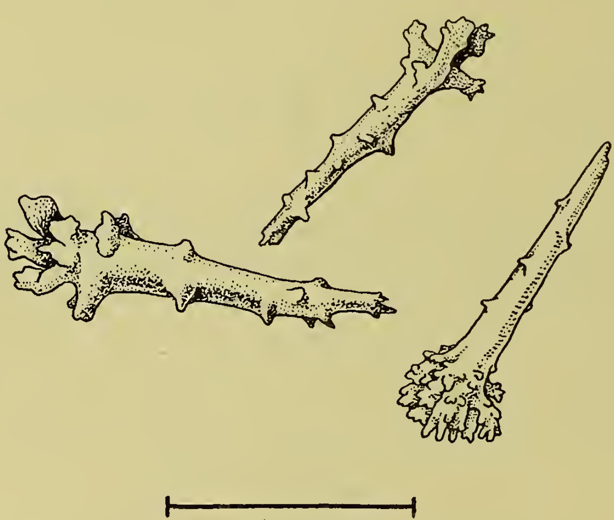
Sinularia robusta, n. sp. (Plate IV, fig. 6; Plate V, figs. 1, 3.)

Five specimens from different localities require the establishment of a new species. Its main characters are: A solid, heavy, thick-set type of growth, with a thick stem, for the most part not clearly defined from the capitulum, but merging into it in the development of polyp-bearing lobes towards the top. The lobes are thick and somewhat flattened, and grow directly upwards; they may be notched, sometimes deeply cleft to form almost circular, pointed, finger-like processes, or they may form twisting, rather wall-like upgrowths from the capitulum, not very closely folded. The texture is hard, the colour creamy to brown. The small autoozoids, 0·5–1 mm. apart, are evenly and closely set, both on the lobes and centre and sides of the capitulum. There are no siphonozooids. The large warted spindles of the interior are up to 4·5 mm. in length; there are also small, much smoother spindles with few fine simple prominences. The clubs of the cortex are small, of the type with a head with generally no central wart, but composed of a large number of close-set divisions, or simply a flat head with a notched edge. There are a few club-heads with fewer, larger unevenly set warts. They vary in length from 0·07–0·2 mm.,

and across the head from 0·3–0·5 mm. In some respects this species comes nearest to *S. macropodia,* but it differs from it in many particulars.

As the type I choose a fairly small specimen (from Low Isles), which shows both separate upgrowing notched lobes and a small folded lobe of the wall-like type (Plate V, fig. 3). It has a total height of 5 cm. and cross-breadths of 5·6 cm. and 5·8 cm. It is not quite complete, as are none of the specimens. There is an encrusting thin flat base, from which arise 2 rather flattened lobes, each 2·2 cm. high and about 1·8 cm. broad, and also a thick stock 3·7 cm. high covered with polyps, with, on the top, a folded lobe 1 cm. high and one separate simple lobe of the same height. The colour in spirit is creamy ; a field-note states that it was green.

Another very similar small specimen from Low Isles has a height of 5·5 cm. and cross-breadths of 5 cm. and 3·2 cm. A field-note also states that it was green.



Text-fig. 6.—*Sinularia robusta,* n. sp. Cortical clubs.

A larger specimen from Low Isles (Plate IV, fig. 6) shows the more digitate type of growth, where the flattish lobes are higher and split in their upper half, generally into two main divisions, and each of these also deeply cleft into up to 5 or 6 narrow digitate processes. The colony has a height of 7·6 cm. and cross-breadths of 5 cm. and 6·5 cm. The wall of the stalk rises in a straight line at the edge into the marginal lobes, there being no definite edge or beginning to the capitular region. It is torn at one side. There are three close-set main lobes, which divide through a median deep cleft, with, on each side of that, in a straight line, 3–7 subdivisions, into a group of stiff, upright finger-like, rather flattened processes, the apparent length of which is somewhat increased by a fold continuing down from the notch. The average diameter of one of these digits is 7 mm. and its length 1·2 cm.

A large specimen from Reef A, Lizard Island, is an example of the less digitate, more wall-like folding of the lobes (Plate V, fig. 1). Though there are a few separate stout lobes, the surface is, for the most part, covered with twisting flattened ridges, not very close set, as in *S. gyrosa.* Details of zooids and spiculation are exactly the same ; a portion of a flat encrusting base is torn off. There is no direct separation from the stem

and the capitulum, the stem passing straight up into the lobes with no line of demarcation. The colony is 8·4 cm. high, with cross-breadths of 11 cm. and 6 cm.

A small colony from Yonge Reef, Outer Moat, is an even more extreme case of the possible folding of the lobes, which are more closely set than in the previous specimen.

Localities : Reef A, Lizard Island.

Outer Moat, Yonge Reef.

Three specimens from Low Isles.

Genus *Sarcophyton*, Lesson, emend. Marenzeller.

Mushroom-shaped Alcyoniids with a polyp-bearing disc folded round the margin, forming there incipient lobing, and a sterile stalk. Polyps on upper side of disc only ; retractile small, dimorphic. Cortical sclerites are small clubs and slender rods. In disc coenenchyma are longer, slender warted rods and spindles. In stalk coenenchyma are thin or very thick spindles, double spindles or cylindrical sclerites covered with large warts. There is not the zoning of the warts found in *Lobophytum*, except in *S. trocheliophorum*, where the barrel-shaped sclerites of the stalk are often zoned.

Sarcophyton digitatum, Moser.

Moser, Mitt. Zool. Mus. Berlin, IX, 1919, p. 249, 2 figs. ; Roxas, Philipp. J. Sci. L, 1933, p. 380, 1 fig.

A colony from Station XXVII agrees well with Moser's and Roxas's descriptions and figures. In this species the margin of the disc is regularly folded into high folds, which, partly owing to the slightly greater thickness of the disc than in *S. acutangulum* (Marenz.), do not develop the secondary folding seen in the latter species. The edge of the capitulum at the lobes is folded outwards. There are 6 of these simple folds, the highest arising to a height of 4·3 cm. from the level of the centre of the capitulum, with a maximum breadth of 2 cm. The tips of the two longest folds touch each other across the capitulum.

Some of the autozooids are fully expanded up to 5 mm. in length. They are 1–2 mm. apart at the edge of the disc and up to 5 mm. apart in the centre. At the margin there are 1–3 siphonozooids between two autozooids and in the middle up to about 7 or 8.

The spiculation shows short stout clubs, with a well-marked spiny head, the longest measured having a length of 0·3 mm., the maximum breadth being 0·9 mm. The coenenchyma holds very smooth slender spindles with few simple thorns. These spindles may be 0·37 × 0·015 mm. in size. In the stem are spindles (average dimensions 0·25 × 0·04 mm.) covered with simple prominences and only very occasionally with heavy compound warts.

The height of the colony is 7·8 cm., but the stem has grown 5·4 cm. horizontally before bending sharply up at right angles. If straightened out the total height of the stem would be about 10 cm. The maximum diameter of the capitulum is 6·5 cm.

Moser describes the disc of his specimen as soft ; in our specimen the texture is quite firm, though it yields to pressure of the fingers.

Locality : Station XXVII. Dredge.

Previously recorded from the Philippines.

Sarcophyton elegans, Moser.

Moser, Mitt. Zool. Mus. Berlin, IX, 1919, p. 252, 2 figs. ; *S. convolutum*, Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 63, 2 figs.

A small brown, rather dried-up colony from Station XIX can be referred to this species. It shows the thin margin of the disc thrown irregularly into low rounded folds, broader than high, which turn in towards the centre. The autozooids are large and very scarce in the centre of the disc, more crowded on the margin. The siphonozooids are small and very numerous. The spiculation agrees closely with Moser's description. The colony is small, typical of the species. It has a total height of 4·2 cm., and a maximum capitulum diameter of 4·4 cm. *S. convolutum* is a synonym of this species and not of *S. acutangulum* as considered by Roxas (' Philip. Journ. Sci.', vol. 1, No. 4, 1933, p. 371). The folding of the disc, size and number of zooids and spiculation all agree, rather than with *S. acutangulum*, which it differs from in many particulars.

Locality : Station XIX.

Previously recorded from Philippines.

Sarcophyton glaucum (Quoy and Gaimard).

Marenzeller, Ueber die *Sarcophytum* benannten Alcyoniiden, Zool. Jahrb., I, 1886, p. 352, 3 figs. ; Burchardt, Alcyonaceen von Thursday-Island und von Amboina, Denkschr. Med.-Naturw. Ges. Jena, 1898, p. 676, 3 figs. ; Thomson and Dean, Alcyonacea of the Sigoba Exped., Monogr. XIII*d*, 1931, p. 57, 2 figs.

A dark grey colony (marked " General Survey, A. 1 ") with a height of 6·5 cm. has a capitulum (4·5 cm. in diameter) showing the soft flexible texture, the very large autozooids, some of which are expanded, and the clear siphonozooids all typical of the species. The margin is convoluted in a few large folds. Also typical is the presence in the stalk of markedly large spicules, warty spindles, which are often so large in this species that young forms are apt to be confused at first sight with a young *Sinularia*, where these large spindles are typical. The usual club-like spicules of *Sarcophyton* species are, in *S. glaucum*, long in proportion to their breadth, with a very ill-defined head.

Another young colony from Maer Island, greenish grey in colour, with the capitular margin convoluted in high, close folds, is rather finer in texture, but shows very typical spiculation.

Another dense grey small colony from Low Isles has a height of 3·3 cm. and an almost circular capitulum with a maximum diameter of 2·4 cm.

Localities : Maer Island, N.W. Reef Flat, 11th May, 1929.
Low Isles, General Survey A. 1.

Very wide distribution—Australia, Philippines, Amboina, Red Sea, etc.

Sarcophyton trocheliophorum, Marenz.

Marenzeller, Zool. Jahrb., I, 1886, p. 359, 2 figs. ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 60.

Five colonies all showing the characteristics of this species. The margin of the disc, which has a smooth rubbery surface, is convoluted into thick folds, the folds being more numerous in the largest colonies ; the siphonozooids are clear to the naked eye, but only

slightly depressed ; most characteristic, the spicules of the stalk include broad, round-ended or blunt cylinders, with 2 or more median zones and 2 terminal clusters of large compound warts. The zoning of the warts in these spicules, common in the genus *Lobophytum* but unusual in *Sarcophytum*, is a good diagnostic feature of the species. All the autozooids are contracted save in one small colony, where they are partially expanded.

The largest colony, greenish cream in colour, with the margin of the disc convoluted into about 10 main thick folds, has a maximum disc diameter of 10 cm., and a stalk 3 cm. high on one side, but only 1 cm. high on the other. There are up to 12 autozooids to a centimetre at the margin, but only about 4–9 to a centimetre in the centre of the disc.

An abnormal specimen, growing on a piece of madrepore (marked " General Survey, A. 1 "), consists of a fairly large colony with a stem 3·5 cm. high and 1·8 cm. in diameter, with a nearly circular disc, about 3·5 cm. in diameter, the margin showing the beginnings of 3 or 4 folds. Growing out from the stem, about $\frac{1}{2}$ cm. from the margin of the disc, is a small round disc, too small for any folding of the capitular margin. Apparently normal autozooids and siphonozooids cover it in the usual way. About half way down the stem of the main colony on the other side from the budded small colony another stem grows outwards and downwards, with a maximum diameter of 11 mm. and a length of 2·8 cm. This abnormal outgrowth would seem to have been attached to some adjacent support, from which it has been torn away. From the base of the main stem grows out sideways yet another small colony, with a disc 1·8 cm. in maximum diameter and a stem 1·7 cm. long and 8 mm. in maximum diameter. The colour varies from cream in the stems and subsidiary colonies to brown in the disc of the main colony.

LOCALITIES : Low Isles, Detailed Survey II.

General Survey A. 1 ; A. 4 ; A. 5.

Very wide distribution—Red Sea, Madagascar, Ceylon, W. Australia, Philippines, etc.

Genus *Lobophytum*, Marenzeller.

Massive Alcyoniids with polyp-bearing disc sharply deliminated from the stalk and thrown up into lobes or finger-like processes. The polyps, small, close-set, retractile, dimorphic, the siphonozooids showing clearly to the naked eye. The spiculation is distinctive owing to the constant zoning of small spindles ; clubs may be present, but are not numerous, as in *Sinularia* and *Sarcophyton.*

Lobophytum crassum, Marenz.

Marenzeller, Ueber die *Sarcophytum* benannten Alcyoniiden, Zool. Jahrb. I, 1886, p. 363, 4 figs.

Several colonies from various localities seem to me to be referable to this variable species. A field-note by Prof. Stephenson states, " Smooth form with radially flattened combs. Grows to a large size. Common " ; while another field-note in one of the bottles (the third specimen described here) states, " Grey with light tips tending to green, forms cockscombs when large " (see photo). The majority of the specimens show in a varying degree flattened lobes subdivided along the edge in a cockscomb-like manner, but sometimes the secondary lobes are prolonged into digitiform processes, or a digitiform lobe may arise itself direct from the capitulum.

A colony labelled " Detailed Survey II " has a height of 6·6 cm., a breadth of 8·4 cm. and

a thickness of 4 cm. The growth is very irregular, the depth of the sterile stalk varying very much on all sides. At its highest it is 2·5 cm. high and at its lowest 9 mm. The lobes are cockscomb-like, their growth is also irregular, but they are all more or less directed towards the centre. One is more deeply notched, with a rather digitiform flattened lobe 2·5 cm. long and 1·4 cm. broad. The texture is gritty, but the lobes yield to the pressure of one's fingers. The autozooids are closely set, on an average about 1 mm. apart; the siphonozooids are clear, and at the tips of the lobes there are only 1 or 2 between 2 autozooids. The colour is creamy. The spicules of the stalk are short stout rods, with a cluster of warts at each end and 2 median zones of compound warts. The majority of these are about 0·18 mm. long, but there are a few up to about 0·26 mm. which are narrow and with 4 zones of warts. The majority of the shorter spicules are very blunt-ended, but some, especially the longer ones, taper more at the ends. The spicules of the capitulum are long narrow tapering spindles, with, in most cases, the warts arranged rather irregularly over their surface, but in some with a definite zoning. They are up to 0·35 mm. long, with an average breadth of about 0·05 mm., but up to 0·7 mm. broad. Small clubs are present in the rind of both stalk and capitulum.

Several other colonies have spiculation closely the same as this, as well as features of growth. A colony from General Survey, A. 1, with a height of 8·8 cm., of which about 4·9 cm. is stalk, has a more regular type of growth in the lobes, which are more closely set and compact, making the capitulum a more solid rounded mass of lobes directed towards the middle. Texture, colour and zooids are the same.

Another similar specimen, from an unmarked locality, incomplete, with a height of 8 cm., shows a large cockscomb 6·6 cm. high and 4·3 cm. long, divided into 3 deep main notches, each of which are subdivided into 2 or 3 smaller notches. There are other smaller combs, and a digitiform single lobe, 6 cm. high, which is rather flattened and gives off a very small lobe at each side. The lobes and combs are not closely adjacent or touching each other, as in the previous specimen.

An incomplete colony, only half of which remains, from Yonge Reef, Outer Moat, is harder in texture, brown in colour, agreeing as to size and number of zooids. Round the edge of the capitulum are stout, short. simple lobes; beyond these, towards the centre, are 2 closely adjacent low folds with a wavy upper edge. The larger of these is 7 cm. long, about 2·5 cm. high and 8 mm. thick, but it is not complete in length, one side showing a broken edge. The spiculation of the base is slightly heavier than in the preceding specimens, with a greater proportion of 4-zoned stout barrels, but the spicules of the capitulum are rather shorter and stouter, up to 0·3 mm., with an average breadth of 0·07 mm. and with a maximum breadth of 0·09 mm. These tend to have the warts arranged more regularly in zones, though in many the zoning is weak. The total height of this colony is 6·6 cm., its length 4·5 cm. and its breadth 4 cm. The maximum height of the rather uneven sterile stalk is 5·8 cm. Another fragment of a colony from the same locality with similar colour, texture and spiculation shows 6 rather close-set simple lobes (up to 2·3 × 1 cm.) with the tips sloping together.

An almost circular, broken specimen (with 2 small fragments) from Low Isles has a total height of 4·9 cm., a diameter of 7 cm. and a stalk of 1·5 cm. high. It has a capitulum, well marked off from the stalk, with 5 high folds radiating rather regularly towards the centre, where they meet. The folds are 2·5 cm. high and 7 mm. thick. Autozooids and siphonozooids are as in the previous specimens. The colour is brownish,

the texture hard. The tops of the ridges are slightly wavy and with an occasional not very deep notch. The spiculation of the base is very heavy: the unusually stout barrel-like forms are up to 0·25 mm. with a breadth of up to 0·12 mm., with 2 to 4 zones of very heavy warts. The 2 median zones are rather widely separated by a well-marked central waist. The spiculation of the head is also dense, with heavy pointed spindles up to 0·35 × 0·1 mm., with zoned or unzoned warts.

Localities: Detailed Survey II of Low Isles.
General Survey of Low Isles, A. 1.
Yonge Reef, Outer Moat (2 specimens).
"Low Isles" (2 specimens).

Very wide distribution, *e. g.* British East Africa, Philippines, Mermaid Straits.

Lobophytum crebriplicatum, Marenz.

Marenzeller, Ueber die *Sarcophytum* benannten Alcyoniiden, Zool. Jahrb. I, 1886, p. 362, 1 fig.

A small colony from Low Isles, with a total height of 2·9 cm. and a capitulum measuring 3 cm. × 2 cm. with a height of 2·6 cm., is cut through the stem, only about 3 mm. of which remains. The capitulum shows seven radially-directed, closely-set folds of rather even dimensions. On these the autozooids are 1–2 mm. apart, and between these lie the clearly seen siphonozooids, about one or two between two autozooids on the tops of the lobes. In addition to the usual clubs in the rind, the spicules of the capitulum are spindles up to 0·4 mm. long and ·07 mm. broad, with scattered and irregularly arranged warts. There is little regular zoning of the warts. The spicules of the base are warted spindles also with practically no zoning of the warts. The majority of these do not exceed 0·28 mm. or 0·3 mm. with a breadth of about 0·1 mm., but a very few narrow long spindles reach a length of 0·45 mm. with a breadth of 0·06 mm. The spicules agree with Marenzeller's figures. The texture is rather hard and gritty, and the colour is cream, stained with brown. Another difficult small specimen from the same locality, which I tentatively include as possibly within the varietal limits of this species, taken at the same time as the other, shows also radially-directed lobes, but of more unequal sizes. The colony has a total height of 4 cm., of which 2 cm. is sterile stalk. There are 11 lobes, 8 of which are very undeveloped and merely stumpy simple upgrowths, only beginning to be slightly flattened in a radial direction; the other 3 are more developed, two of them simple flattened ridges; the third, as with the others directed towards the centre, with a median notch. The largest lobe has a height of 2·2 cm., a length of 2·5 cm. and a thickness of 6 mm. The size and distribution of the zooids are similar to the preceding specimens, but the spiculation shows some differences. The spindles of the capitulum are, taken as a whole, longer and more slender. They reach a length of 0·5 mm., with a breadth of 0·04 mm. The spicules of the base show much more regular zoning, more crowded warts and more symmetrical outlines. They include zoned spindles up to 0·4 mm. in length, with up to 10 close-set dense whorls of compound warts very regularly arranged, in other cases with more irregularly set warts. There are also short stout spicules with two zones of warts.

The texture of the colony is firm, but yields slightly to pressure of the fingers. The colour is a creamy grey.

Locality: Low Isles.

Previously recorded from Tonga and the Philippines.

Lobophytum gazellae, Moser.

Moser, Mitt. Zool. Mus. Berlin, IX, 1919, p. 274, 2 figs.

A small colony from Low Isles, A. 5, seems referable to this species. A rounded stalk, 3·2 cm. in maximum diameter and 2 cm. high, bears a lobed capitulum, 3·2 cm. in maximum height. The lobes, which have an average thickness of 6 mm., arise round the edge as thick stumpy digits, or grow in towards the centre as flattened plates with a wavy upper edge. The autozooids are small, about 10–12 to a centimetre ; the siphonozooids are minute, and on the tips of the lobes are 1–3 in number between two autozooids. The spicules of the capitulum include the usual small clubs and spindles, unusually stout and massive, blunt-ended, with few large, irregularly arranged warts, which project so unevenly that the spicule as a whole is very jagged and irregular in outline. In some the warts are arranged in rather ill-defined whorls. Common dimensions of these " massive " spicules are 0·28 × 0·1 mm. There are also more slender pointed spindles, up to 0·43 mm. long, with irregularly arranged finer warts. In the stem are stout barrels, with 2 to 4 zones of large warts, or with the warts irregularly arranged, and with an asymmetrical outline to the spicule. Common dimensions of these spicules are 0·22 × 0·08 mm. There are also a few slender spindles up to 0·29 mm. with small, rather widely-set warts arranged in zones. A large number of crosses varying from almost simple to very warted forms are present both in stem and capitulum.

LOCALITY : General Survey of Low Isles A. 5.

Previously recorded from New Ireland, Philippines.

Lobophytum lighti, Moser.

Moser, Mitt. Zool. Mus. Berlin, IX, 1919, p. 289, 2 figs.

Four specimens agree very well with Moser's species from the Philippines. The largest colony bears a close resemblance in actual size and appearance to the photograph of his type, and details of spiculation, etc., agree well in all four specimens. The colour is creamy, the texture very soft, especially in the more expanded colonies. The lobes, often somewhat convex on one side and concave on the other in a kind of folding, are long and finger-like in the largest specimen ; some are simple, in others two lobes unite near the base to form a stalk. They arise round the edge of the colony, so that in the largest specimen a smooth bowl results in the middle. In the smaller specimens where the lobes are necessarily more congested this is not seen so clearly. The expanded autozooids are about 1 mm. apart on the lobes, up to 5 or 8 mm. apart in the centre of the disc ; the siphonozooids are large and clearly seen.

The spiculation, described in detail by Moser, shows no variation from his description. This is one of the species where the stalk includes numerous pointed spindle forms as well as the blunt-ended barrel types. The largest specimen from Low Isles has a height of 5·2 cm., a head diameter of 4 cm., a sterile stalk 3·7 cm. high. There are lobes all round the edge of the capitulum. These may fork into two long digit-like processes : one lobe, for instance, rather flattened, is 1·1 cm. high, and forks into one process 2·6 cm. long and a shorter one 9 mm. long. There are several unbranched lobes, varying in length from undeveloped knobs to long digits 3·1 cm. long and 1 cm. broad at the base.

Two small colonies, one marked " locality unknown. Probably Low Isles ", the other

from General Survey of Low Isles. A. 4, are very similar in size and form. They show all the same general characteristics as the previous specimen, except that as younger colonies the lobes are not so long proportionally. The taller of the two colonies has a height of 5 cm., a stem 2·8 cm. high, and a capitular spread of 3·8 cm. The longest undivided lobe is 2·5 cm. in length, rather flattened, with a maximum breadth of 1·3 cm.

LOCALITIES: Low Isles.

General Survey of Low Isles, A. 4.

Previously recorded from the Philippines.

Lobophytum pauciflorum (Ehrbg.). (Plate III, fig. 1.)

L. candelabrum, Roule, Alcyonaires d'Amboine, Rev. Suisse Zool. XVI, 1908, p. 177, 4 figs.; Lüttschwager, Beiträge zu einer Revision der Familie Alcyoniidae, Arch. Naturgesch., Abt. A, Heft 10, 1915, p. 32, 1 fig.

Two colonies from Low Isles agree closely with Roule's description and figures of *L. candelabrum*, which, according to Lüttschwager, is synonymous with *L. pauciflorum*, Ehrbg. Certainly it agrees well with the characters of that species, though it may be found that Roule's and the Barrier Reef forms are a distinct variety from the original Red Sea specimens.

Both colonies show the distinctive features of the species: they are broader than high; the capitulum is marked off sharply from the low sterile stalk, which shows fine longitudinal striations; the former is covered with a number of finger-like lobes, and rounded at the summits, which may arise singly from the capitular surface or 4 or 5 in a row from a fold or ridge in the capitulum. The polyps are less numerous than in many species of *Lobophytum*, up to 4 mm. apart on the lobes, though more crowded round the tips and more scattered still on the flat basal lappets. The siphonozooids are very clear to the naked eye and very numerous, up to 10 or 12 between two autozooids on the lobes.

The spicules of the capitular lobes include small clubs, not very numerous, and long pointed spindles, with the warts in zones or irregularly scattered. These are up to 0·4 mm. long, and have a breadth of about 0·05 mm. The spicules of the sterile stem are stout, blunt-ended, barrel-like spicules with usually 4 zones of heavy warts and with a group of warts at each end. The majority of these are about 0·2 mm. long and 0·9 mm. broad, but a few more pointed forms are up to 0·3 mm. in length and 0·07 mm. broad.

Both colonies are incomplete, cut through the middle. One has a height of 5 cm., a length of 7 cm. and a breadth of 4 cm. There are 5 main folds which give rise to the finger-like lobes. The largest of these folds is 2·9 cm. long, 4 mm. thick and 1·3 cm. high on one side, but only 5 mm. high on the other, and gives rise to 4 upright lobes, the longest of which is 2 cm., with a breadth of 7 mm. In addition to the folds are simple digitiform upgrowths from the flat capitular surface. The stalk has a height of 3·1 cm. The other incomplete colony with a height of 6·6 cm., a length of 8·3 cm. and a breadth of 5·3 cm. shows two long ridges running parallel to each other along the length of the capitulum. One ridge has a height of 2·3 cm. and gives rise to 11 lobes, the biggest 2·5 cm. in height; the other ridge has a height of 1·3 cm. and gives rise, along its crest, to 7 nearly parallel fingers. In addition are one or two solitary upright fingers, the longest of which is 3 cm. in height and 1 cm. in diameter.

The texture of both colonies is firm and hard, and the colour is a slightly greenish dull yellow.

Locality : Low Isles.

Previously recorded from Red Sea, Amboina, New Zealand, etc.

Lobophytum pauciflorum var. *validum*, Marenz.

Marenzeller, Ueber die *Sarcophytum* benannten Alcyoniiden, Zool. Jahrb. I, 1886, p. 367, 1 fig.

A fragment of a colony from Detailed Survey II seems to me to be referable to this variety. It shows the high folds deeply notched into rounded, finger-like branches described in the type, and the details as to zooids and spiculation also agree with Marenzeller's original description. The fragment has a total height of 9·8 cm. and a stalk height of 4·8 cm. Its maximum breadth is 6·7 cm. The texture is firm and brittle, and the colour is brownish-yellow, with the autozooids standing out as very small dark specks. On the lobes the autozooids are 1–3 mm. apart, but towards the centre they are as much as 5 mm. apart. The siphonozooids are very small, but clear to the naked eye, 4–5 in 2 mm.

The capitulum gives rise to two main folds. The larger one is not complete, the tips of the larger digitiform processes into which it divides being broken off. The breadth of this flat fold is 6 cm., its thickness 1·5 cm. and its height 3·7 cm. It gives off 2 short lobes, also 1 medium-sized one and 2 that, if complete, would obviously be very large ones. The longest of these broken finger-like processes is 4·2 cm., very slightly flattened, almost circular, with a maximum diameter at the base of 1·8 mm.

Another smaller main fold gives rise to two short lobes and 2 digit-like ones.

The spicules of the capitulum, in addition to the usual small clubs of the rind, include stout, rather blunt-ended spindles up to 0·42 mm. long and up to 0·1 mm. broad, with compound warts arranged either irregularly or in more or less regular zones. The barrel-shaped spindles of the interior of the stem are very heavy, with very regularly arranged zones of warts. They are up to 0·25 mm. long and 0·13 mm. broad. The spicules of both stem and head agree closely with Marenzeller's figure.

Locality : Low Isles, Detailed Survey II.

Previously recorded from Andamans, Tonga, Funafuti.

Family Nephthyidae.

Genus *Capnella*, Gray.

Nephthyids of upright, stout growth, tree-like or bushy. Polyps grouped on lobes, incurved and without a supporting-bundle, non-retractile. Canal-walls with numerous scattered spicules. Spicules of outer covering, polyps and canal-walls foliaceous and spiny clubs. Crosses and spindles are also found in canal-walls.

Capnella fungiformis, Kükenthal.

Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, 1, Zool. Jahrb. XIX, Syst., 1903, p. 133, 4 figs.; Thomson and Mackinnon, Alcyonarians Collected on Percy Sladen Trust Exped., Trans. Linn. Soc. Zool. London, XIII, 1910, p. 179, 1 fig.; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 71, 2 figs.

A small bushy colony, with one broken-off twig, from Low Isles, coral head on seaward slope of reef, has a height of 3·3 cm. and a maximum spread of 2·5 cm. The

base of the stem, which is broad and flattened, has diameters of 8 mm. and 2·6 cm. The colour in spirit is brownish, lightening to a dirty cream colour on the polyps. The incurved polyps are up to 1·5 mm. long, and form a dense covering on the lappets. The lappets are crowded and start branching from very near the base of the barren stem, which shows longitudinal striation, probably due to post-mortem shrinkage.

The type of spiculation throughout is in agreement with that of this species. The polyp armature consists of irregularly arranged, bent, thorny spindles (up to 0·45 mm.), and warty clubs which may show slight foliation at the thick end. The size of these polyp spicules is larger than in the type described by Kükenthal (the maximum length given was 0·2 mm.) and than in the specimens from the "Siboga" Expedition, and agrees more with the dimensions given by Thomson and Mackinnon (up to 0·408 mm.) for their specimen from Coetivy. In all other points the specimen agrees with the type very closely, and there does not seem sufficient reason to consider it other than a variety of the species. The spicules of the stem include the typical oval or barrel-shaped spicules and double spheres with the warts arranged in zones.

Locality : Low Isles, coral head on seaward slope of reef.

Previously recorded from Indian Ocean (Coetivy and Dar es Salaam) and Dutch East Indies.

Capnella imbricata (Q. G.).

Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, 1, Zool. Jahrb. XIX, Syst., 1903, p. 129 ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 71, 3 figs.

Two greenish-grey colonies from Maer Island. The larger consists of two main trunks, each about 4·5 cm. high and 3·7 cm. in diameter, united at the base, where they grow very symmetrically on a piece of madrepore. The tops of the two sterile trunks are covered with a close mass (up to 1·8 cm. high) of polyp-bearing lappets, the polyps characteristic of the genus *Capnella* overlapping each other and densely covered with an armature of foliaceous clubs. The spicules, which have been described previously in detail, include small foliaceous clubs, some short, others with elongated stem ; 4-rayed stars and crosses mostly heavily warted ; rough, very warted spheres, with sometimes a hint of being quadriradiate. The smaller colony has diameters of 2·5 and 4·9 cm., and a height of 6 cm., of which about 2 cm. is made up of the bare trunk.

Locality : Maer Island, North West Reef Flat.

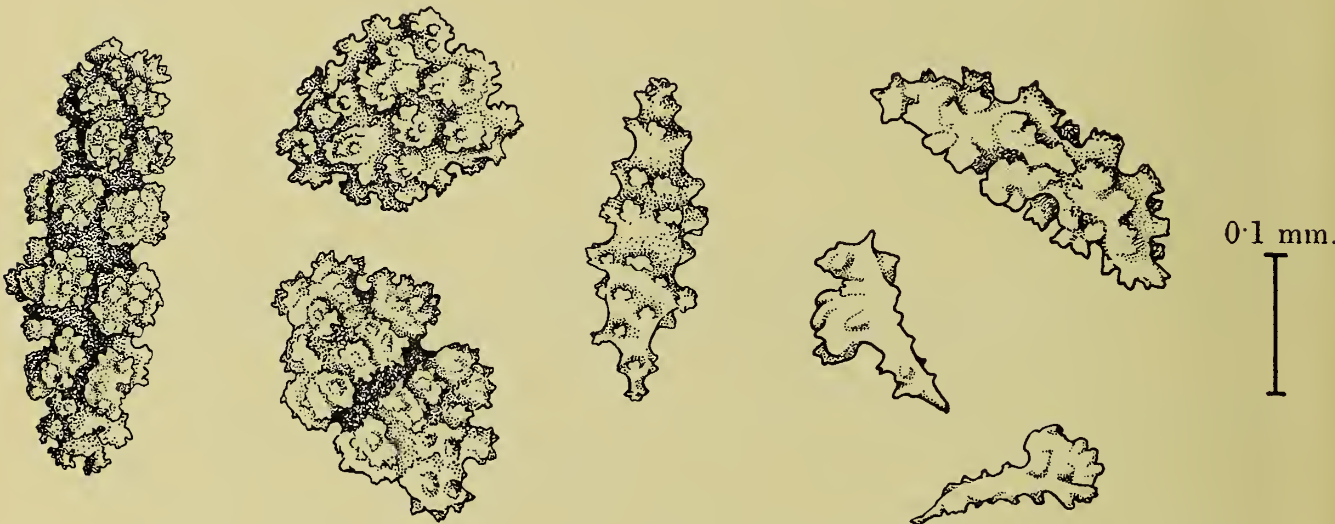
Previously recorded from New Ireland, the Philippines, Dutch East Indies.

Capnella lacertiliensis, n. sp. (Plate IV, fig. 5.)

A distinctive specimen of this genus from Coral Patch, Undine Reef, has a remarkable resemblance to a lizard skin owing to the rather green-grey coloration and the somewhat regular arrangement in rows of the small incurved and flattened polyps. As in my opinion it is certainly a new species, and as it has been given on the label the tentative description, " Lizard Skin Lobophytum ", I propose as a name for it *Capnella lacertiliensis*.

The total height of the hard rigid colony is 2·6 cm. ; the low broad stem is practically unwrinkled, hard and harsh to the touch, and for the most part has an average height of 5 cm., though at one side it is 1·3 cm. high. It has basal diameters of 1·9 cm. and 1·1 cm.

From the flattened upper surface of the stem arise the polyp-bearing lappets, which have an unusual shape for a *Capnella* species, and are suggestive of the type of growth in the lobes of some Lobularias, *e. g. L. pachyclados*. The majority of the lappets are slightly flattened and their sides slope to a rather sharp-edged crest or summit, which may be slightly indented in the middle or twice. Some of the larger lappets are compound, consisting of a base which splits into 3 or 4 secondary lappets closely pressed together. The maximum height of a lappet is 1·2 cm. and a maximum breadth also 1·2 cm. The maximum diameters of the polyp-covered lappet region are 3·3 cm. and 2·5 cm. The polyps are extremely small and flat, about 0·09–0·1 mm. in length and 0·06 mm. in breadth. They lie in true *Capnella* fashion closely adjacent, with the mouths pointing upwards and incurved to the surface of the lappet. But there is very little actual curvature in the base of the polyp, which, when viewed under the microscope, appears to be speckled with



TEXT-FIG. 7.—*Capnella lacertiliensis*, n. sp. Spicules.

white. These white specks are the foliaceous heads of the small club-spicules with which the back of the polyp is armed, and which grow so that only the heads appear beyond the surface of the polyp wall, and make it roughened. The majority of the clubs have a length of about 0·14 mm., but they range from 0·09 mm. to 0·19 mm. Some are true clubs, with straight folia in line with the handle, but in others the folia project sideways at the tip of the head, and in a few from near the middle of the handle, so that they form miniatures of the triradiate type found in *C. rugosa*. The spiculation of the polyps, with its rough surface caused by the projection of folia from the polyp wall, is comparable to that in *C. rugosa*, but is very much more delicate, and the folia never approach the large dimensions found in the latter species. The largest folia are 0·05 mm. high, while in *C. rugosa* they are more than double the size.

The lappets, in addition to the actual polyp spicules, include the following types of spicule : (*a*) Stout, blunt-ended or pointed spindles covered with large compound warts, in most arranged in zones (up to 0·28 × 0·13 mm.), though in some the warts are irregularly arranged. Very common are types with 4 zones and 2 terminal clusters of warts ; (*b*) there are also more slender-pointed spindles with a few simple or slightly

compound prominences (average dimensions, 0·22 × 0·05 mm.). In the stem are types the same as (*a*), but the majority are shorter and stouter barrel-like forms, with a median waist, and two zones and terminal clusters of compound warts (average dimensions 0·2 × 0·12 mm.). There are also some almost circular forms densely covered with compound warts. The canal-walls are very densely filled with spicules, which partly account for the extreme rigidity of the stem. The colour of the stem is brown, and the lappets are a greeny-grey speckled with lighter grey polyps.

Locality : Coral Patch, Undine Reef.

Capnella rugosa (Kükenthal).

Kükenthal, Alcyonacea, Wiss. Ergebn. der Deutschen Tiefsee Exped. XIII, 1, 1906, p. 68, 4 figs.

A small brownish-grey colony from Station XXV agrees well with Kükenthal's description of this distinctive species of *Capnella*, previously recorded from the Indian Ocean, on the South African coast. A very short sterile stem gives rise, at a height of 2–3 mm., to a number of extremely short branches, which divide into polyp-bearing lappets, up to 7 mm. in length and 4 mm. in breadth. The polyps are densely crowded on these, overlapping each other.

The most striking feature of the species is the very heavy armature of the polyps. The spicules form a close covering on the polyp wall of bent or nearly straight, warted spindles, with a median or nearly terminal mass of high folia, which project from the polyp wall, giving it a very rugose appearance. The spindle with the projecting folia forms a triradiate. The largest of these spicules measured 0·42 mm. from tip to tip of the slightly bent spindle and with folia projecting 0·12 mm. from this. None of the spindles were as long as 0·65 mm.—the figures given by Kükenthal as the maximum length. We do not feel justified, however, in making a new species on this account, as the colony is a very young one, and its characters, apart from these spicule measurements, agree very closely with those of *C. rugosa*. Also present in the polyps are foliaceous clubs and warty spindles, and in the rind of the stem are irregular stellate forms and warty capstan-like forms, as figured by Kükenthal. In addition there are warty spindles and a few clubs, some with a foliaceous head.

Locality : Station XXV. Dredge.

Previously recorded from Indian Ocean, South African coast.

Genus *Lemnalia*, Gray.

Nephthyids branching like trees, long bare stem and branches giving rise to twigs on which are grouped the non-retractile polyps, which arise singly or in bundles or groups. Polyps with no supporting-bundle. Spiculation very dense, but all spicules of a delicate type. Stem cortex smooth and often semi-transparent, through which show vertical lines of canal-walls. Stems very fragile and brittle. Two typical forms of spicule are the fine-warted spindle and a crescent or bow-shaped form, with 2 basal warts. Derivatives of these types, *e. g.* crosses, are also present. The tentacular spicules are minute, finely-warted spindles or flat-sculptured scales.

Lemnalia brassica (May).

Ammothea brassica, May, Jena. Z. Naturw. XXXIII, 1899, p. 139, 1 fig.; *Lithophytum brassicum,* Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, 1, Zool. Jahrb. XIX, Syst., 1903, p. 120; *Lemnalia brassica,* Kükenthal, Alcyonaria des Roten Meeres, Denkschr. Akad. Wiss. Wien, LXXXIX, 1914, p. 15; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 76.

Two colonies from Maer Island, N.W. Reef Flat, are neither quite complete, but torn off at the base of the stem. One colony, 6·8 cm. in height and with diameters of 4·5 cm. and 6·8 cm., is the more typical in its rather cauliflower-like form of growth. The sterile stem, torn and slightly flattened, is 2·6 cm. in height and with a maximum diameter of 2·3 cm. It gives rise to a branched polyp-bearing region, where the twigs are short, rounded or stumpy, flattened at the tips and closely pressed together. They are densely covered with polyps, and on an average have a height of 7 cm. and a breadth of 5 or 6 cm. One side of the colony is less densely covered with polyp-bearing twigs and the growth appears more open. The polyp size agrees more closely with the measurements given by May for *Ammothea* (*Lemnalia*) *bauiana,* which was merged by Kükenthal into *L. brassica.* They are up to about 1 mm. in height.

The spicules include finely warted, slightly bent spindles up to 0·38 mm. in length and 0·02 mm. broad. There are also smaller spindles with a few warts towards the middle, and also bow-forms with the large median basal warts so that a somewhat 4-rayed form is produced.

The second colony is larger, with a total height of 7·5 cm. and a maximum spread of 8 cm. The growth here is less typical and more open, like a cauliflower which is over-ripe and has begun to sprout. Some of the twigs have kept their short rounded shape and are closely adjacent to each other, but others are more elongated and less closely pressed together. All the other characteristics are, however, identical.

The colour in both colonies is pale cream and the stems show fine, longitudinal striations (owing to the same transparency of the stem revealing the canal walls), and have a peculiar brittleness typical of *Lemnalia* species owing to the great number of very fine spicules in the numerous canal walls.

Locality : Maer Island, N.W. Flat.

Previously recorded from Baui Island (near Zanzibar) and Savu (Dutch East Indies).

Lemnalia elegans (May).

Ammothea elegans, May, Jena. Z. Naturw. XXXIII, 1899, p. 139, 1 fig.

A colony from Station XXVII, which agrees closely with May's description and figure, shows the stout stem and primary branches, with delicate polyp-bearing twigs towards the top of the colony, characteristic of the species. Also characteristic is the spiculation with (*a*) the spindles unusually large for the genus, in our specimen up to 0·52 mm. long and 0·03 mm. broad. (May's measurements were up to 0·47 mm. long and 0·03 mm. broad.) (*b*) What May describes as " numerous double-clubs ", up to 0·09 mm. long. These are like the double-capstans described in *L. digitiformis*, n. sp., but the ends are more heavily warted. Irregular, almost stellate forms are derivatives of these, and there are also a few quadriradiates and transitorial stages between the double-club and the quadriradiate.

The colour is creamy white.
Locality : Station XXVII. Dredge.
Previously recorded from Tumbatu, South Reef (East Africa).

Genus *Paralemnalia*, Kükenthal.

Genus very closely allied to *Lemnalia* and showing similar features of spiculation and brittle texture. Polyps, however, are retractile, and mode of growth somewhat different. A stout common base gives rise to a number of finger-like stems, which are unbranched or branched very simply into further finger-like processes. There is none of the fine branching into delicate twigs found in *Lemnalia*. The polyps are found all over the branches and stems, not confined to the terminal twigs and branches as in *Lemnalia*.

Paralemnalia digitiformis, n. sp. (Plate IV, figs. 1–3.)

Four colonies, two from Batt Reef, one from Escape Reef and one from Undine Reef require the establishment of a new species. Two specimens (1933.5.3, 249, 299) in the British Museum from Portuguese East Africa show the same distinctive characteristics, and should be considered as an Indian Ocean variety of the species.

The specimen from Escape Reef is in the best state of preservation and shall be regarded as the type (Plate IV, figs. 1, 2). It is 6·8 cm. in height. The colony is somewhat flattened, and has a breadth of 4·9 cm. and a thickness of 2·4 cm. The stalk, which shows faint longitudinal striations at a height of 2·3 cm., gives rise to several stout branches, which redivide into secondary and tertiary branchlets, or unbranched long digitiform lobes may arise direct from the surface of the stalk. One such, slightly flattened, has a length of 2·3 cm. and a breadth of 7 mm. and tapers to a point. There is great variability in the amount of branching in the main branches. They are frequently flattened (*e. g.* diameters of 1 cm. and 3·5 mm.) and may show 3 or 4 small lobes at the tip. Halfway down their length may be very small lobe-like twigs, but these may be absent. The tips of the twigs are in most cases blunt or rounded ; the longer more digitiform types are rather more pointed. All the surfaces of branches and branchlets are completely covered with a close mass of semi-expanded polyps, which are so adjacent that in this expanded state they practically touch each other. They are completely retractile within the coenenchyma.

The spicules of the polyp tentacles include sculptured flattened scale-like spicules common in the tentacles of this genus. These, for the most part, have the ends finely sculptured and have two zones of sculptured warts towards the middle. An average length is 0·07 mm. These are also even smaller (about 0·06 mm.) finer spicules, sometimes arcuate and almost smooth, others with two pairs of simple prominences. The polyp wall is covered with numerous small finely-thorned spindles, sloping in vertical rows towards the mouth, but becoming horizontal towards the base of the polyp.

The most common type of spicule which fills the canal walls is the slender spindle covered with fine simple prominences. In the polyparium these are up to 0·37 mm. in length and up to 0·02 mm. in breadth. In the stem canal walls they are much stouter, up to 0·04 mm. broad, sometimes with simple or sometimes slightly compound warts. They reach a length of 0·42 mm.

In the rind of the stem are a great many very characteristic small capstan-like spicules with a median waist and two terminal heads of large warts. The average length of these is 0·06 mm. and breadth across the head 0·05 mm. They are obviously derivatives of the quadriradiates common in *Lemnalia*, but the great majority show no projecting arm or arms. There are, however, some much less numerous quadriradiates and intermediate stages between the capstan type and the latter. The quadriradiates can be described as slightly bowed spindles with two large basal warts. A common length from tip to tip of the bow is 0·18 mm.

The colour of the whole colony is a uniform dirty cream-colour.

A smaller, also flattened colony from Undine Reef (Plate IV, fig. 3) has a height of 5 cm. and breadth of 4·4 cm. and 1·3 cm. The same flattened branches lobed at the tip are present, but the branching is, on the whole, simpler, with fewer of the really short twigs arising from the larger branches. The lobes tend to swell out a little at the tips.

Text-fig. 8.—*Paralemnalia digitiformis*, n. sp. Spicules.

The longest undivided lobe has a length of 1·6 cm. Some of the polyps are semi-expanded, others are contracted. The colouring of the colony is the same as in the Escape Reef specimen.

Two colonies from Batt Reef seem at first sight rather different, but closer examination shows that any differences are probably due to preservation effects, which has caused distortion, contraction or swelling. The lobes are more definitely swollen at the top, but the same flattened branches with 3 or 4 lobes at the tip are there, and also some long undivided lobes, up to 1·5 cm. in length. The colour in both colonies is greyish, with brownish polyps. In the smaller of the two colonies, which has a height of 3 cm. and which is almost circular, with a diameter of 4 cm., the top of the polyparium is almost flat, with the tips of the very flattened lobes all at one level. Looked on from above, they all appear flattened downwards and are compressed together. This may be due to compression in fixation, or it may be an aberrant form. The longest simple lobe has a height of 13 mm. and a breadth of 9·5 mm. The spiculation of all four colonies is the same.

The most characteristic features of this species are the numerous, double-capstan-like, very small spicules from the rind, the mode of growth with its tendency to flattened branches, lobed at the tip, and the extremely numerous retractile polyps. It comes near

to *Paralemnalia flabellum* (Q. G.), but differs from it in spiculation and somewhat in mode of growth.

There is no question that *P. flabellum* (Q. G.), *P. eburnea* (Kük.), *P. digitiformis* and *P. rhabdota* (Bourne) (which, as I have seen from examination of the type-specimen, also has a digitiform type of growth and should be included in the same genus as *P. flabellum*) are species very nearly related to each other.

I have come round to the conclusion that the genus *Paralemnalia*, established by Kükenthal, though very closely related to *Lemnalia*, shows a sufficiently definite difference in habitus to be a valid genus and of definite assistance to the systematist.

I may add that I have found two unnamed specimens in the British Museum (Natural History) from Portuguese East Africa which belong to this new species. They have a very similar type of growth and identical spiculation with the characteristic abundance of double-capstan-like spicules.

LOCALITIES : Escape Reef (common inside reef crest).
Undine Reef. Coral patch.
Batt Reef. 13th September, 1928.

Paralemnalia thyrsoides (Ehrb.).

Ammothea thyrsoides, Klunzinger, Koralltiere des Rothen Meeres, 1877, p. 31, 1 fig. ; *Paralemnalia thyrsoides*, Kükenthal, Alcyonaria des Roten Meeres, Denkschr. Akad. Wiss. Wien, LXXXIX, 1914, p. 16, 2nd pag.

A typical colony of this species labelled " Imitation Madrepore Alcyonarian " is greenish-cream in colour, with an average height of 5 cm., a breadth of 10 cm. and a maximum thickness the other way of 4·2 cm. It forms a solid dense block of stems, many of them characteristically dividing near the base into the branches, which, along with the branchlets, grow vertically upwards closely adjacent to each other. Also characteristic are the large polyps, with prominent, but subsessile, anthocodiae. The spicules are quite typical of the species. This species comes near to *P. flabellum* (Q. G.), but the mode of growth is more compact and typically vertical and compressed, and the polyp tentacles are not brown, as in the latter species.

LOCALITIES : Intermediate Madrepore zone.
Yonge Reef, Outer Barrier, Sub-terminal Area 1.
Previously recorded from Red Sea, Dutch East Indies.

Genus *Umbellulifera*, Thomson and Dean.

Nephthyids with long bare stem and a cauliflower-like unbellate polyparium. The polyps are never arranged in bundles within these umbels. There is no definite supporting-bundle. The polyp armature consists of 8 points in chevron, the 2 inner of these points sometimes being rudimentary or absent.

Umbellulifera planoregularis (Burchardt).

Spongodes planoregularis, Burchardt, Alcyonaceen von Thursday Island (Torresstrasse), Denkschr. med.-naturw. Ges. Jena, VIII, 1898, p. 439, 5 figs. ; *Dendronephthya planoregularis*, Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, ii, 1905, p. 630 ; *Umbellulifera planoregularis*, Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 79.

A small cream-coloured colony dredged from Linden Bank, 28 fathoms, seems to me to be a young colony of this species. It agrees closely with Burchardt's original description.

The polyps are grouped together in umbels, not lappets, but the supporting bundle is very weak, generally consisting of simply one spindle about 1 mm. long, which does not project. The polyp wall shows 8 marked ridges of 5–6 pairs of thorned spindles in chevron. In the rind of the upper stem are warted spindles, the largest seen being 0·7 mm., and, in addition, shorter irregular spindle types (about 0·2 mm. long) with large rounded projections. In the basal rind is a dense mass of small (about 0·15 mm. across) 4-rayed spicules, very thorny.

The total height of the colony is 4·4 cm. The longitudinally wrinkled flattened stem is 3·4 cm. high, with a maximum diameter of 5 mm. At the base it gives rise to some small stolons entangled with debris, and at the top divides into three short main branches, which bear the polyp-covered twigs. The twigs are so approximated to each other that the polyps form a dense umbel-like mass. The cortex of the branches is transversely wrinkled. The colour of the stem and branches is a yellowish grey and the polyps almost white.

The reasons for establishing the genus *Umbellulifera* were described in 1931 (see Thomson and Dean, Alcyon. " Siboga " Exped.). We then suggested that *D. planoregularis* should be included in the genus, but as we had had no opportunity of actually examining the species it was a merely tentative suggestion. After having now seen this specimen, however, if my identification is correct, I have no hesitation in placing *D. planoregularis* in the genus *Umbellulifera* alongside of *U. striata* (Thomson and Henderson). It comes very near to *U. striata*, but it is quite distinct from it, with polyps having more suggestion of a supporting bundle, and a polyp armature with a lesser number of pairs of spindles in chevron.

Locality : Dredge, Linden Bank, 28 fathoms. Stations II and III.
Previously recorded Thursday Island, Torres Straits.

Genus *Nephthya*, Savigny.

Nephthyids with bushy or tree-like growth with the polyps arranged in lobes or catkins. The polyps have a supporting-bundle of spicules, which may or may not project beyond the polyp-head. The canal walls are thin.

Nephthya aurantiaca, Verrill.

Burchardt, Denkschr. med.-naturw. Ges. Jena, VIII, 1898, p. 433, 4 figs. ; Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, 1, Zool. Jahrb. XIX, Syst., 1903, p. 149.

Two very small colonies from Station XII seem referable to this species. The smaller, growing on a twig, is in a better state of preservation than the larger, which is in a rather shrivelled and contracted condition. The height of the smaller colony is 1·5 cm. and its maximum spread 9 cm. It includes four finger-like, polyp-bearing lappets, the first of which arises at the extreme base of the stem. The longest lappet is 6 mm. in length. The armature of the rather large polyps consists of 8 double rows of 4 to 5 pairs of strongly thorned, bent spindles. The supporting bundle is strong, but projects only very slightly or not at all ; the largest twisted spicule seen in a supporting bundle was 1·3 mm. in length. The colour of the stem and lappets is grey-white, the spicules of the supporting bundles red, or yellow shaded with red, the polyp spicules a golden yellow, or in some ployps the spicules towards the base of the points reddish. The general

appearance of the polyp head is golden yellow. The spicules of the basal stem rind are just as figured by Burchardt (Plate 32, fig. 1a).

In the larger colony, which has a height of 2·5 cm. and a maximum spread of 1·7 cm., some of the polyps have spicules which are all red, but many of them show the same colouring as in the smaller colony.

Locality: Station XII. Dredge.

Previously recorded from Torres Straits, China Sea, Shark's Bay (South-west Australia), near Cape Jaubert (North-west Australia).

Nephthya gracillima, Thomson and Dean.

Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 93, 2 figs.

Three specimens dredged from Station XVI agree closely with the type. They show the numerous, very delicate, long, narrow lappets, up to about 1·6 cm. long, which bear the inturned polyps. The polyps have quite a strong supporting bundle of curved, very thorny spindles ensheathing the back and not projecting. At the sides of the polyp are up to 4 pairs of thorny spindles in rather irregular chevron arrangement, and on the ventral side of the polyp is an irregular arrangement of smaller smoother spindles. Some of these are also found lying between the chevroned spindles. The bulk of the cortical spicules are spindles, varying very greatly in size, covered with warts, sometimes jagged spine-like projections more marked on one side. A small proportion of rather irregular forms occur in the lower cortex. They are like truncated spindles with long, projecting processes. On re-examination of the type I find some of these irregular forms occur in the original specimen.

In the largest of the specimens from Station XVI the total height is 8·4 cm., of which 3 cm. consists of sterile trunk. Above this 5 branches are given off which give rise to the polyp-bearing lappets. In one of the smaller specimens the sterile stalk is much longer proportionally, 4·4 cm. in length, to a total height of 8·8 cm. In this colony the twigs are less flaccid than in the other, where they hang limply. The colour of all three is a dirty cream.

Two rather shrivelled colonies from Station XXIII show the same characteristics, but owing to the bad state of preservation are much contorted and wrinkled, and are dull brown in colour.

Localities: Stations XVI and XXIII. Dredge.

Previously recorded from Dutch East Indies.

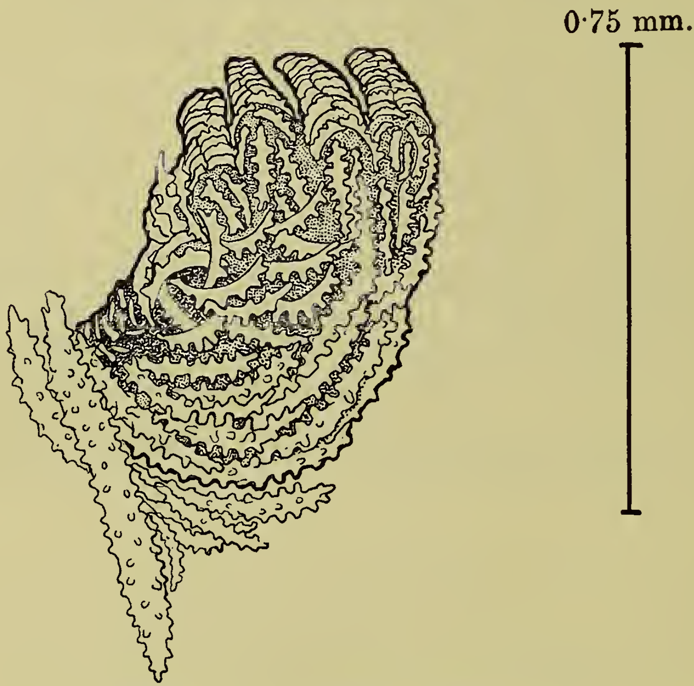
Nephthya mollis, n. sp. (Plate V, fig. 6.)

A bushy, very flaccid colony, grey-white in colour, cannot be referred to any of the existing species. From a membranous base, spreading over madrepore and stone, arise three colonies, two of which are very young, lank and with little branching, one with a total height of 5 cm., the other of 3·8 cm. The third, main stem, with a maximum basal diameter of 2·7 cm., gives off branches practically from the very base. The branching is not in one plane, and there are 6 main branches in all which give rise to the small polyp-bearing twigs or lappets of polyps. These lappets are conical in shape, with rounded summits, but vary very much in dimensions. A twig may be 12 mm. long and 5 mm.

in total breadth, and be covered with polyps arranged in small subsidiary groups of seven or so ; a lappet may give off qutie a distinct subsidiary, usually polyp-covered twig about 2 mm. long near the base, or one may find distinct separate lappets only about 2–3 mm. long arising from the surface of a branch.

The branching approaches the description of that in *N. debilis* (Kük.), but from this species our specimen is separated by the armature of the polyps. Both stem and branches are very relaxed, with deep longitudinal folds in the cortex.

The polyps are small and closely packed on the twigs, and are borne at a very obtuse angle to the short polyp-stalk. The polyp head is about 0·07 mm. broad at the base of the tentacles and on the inner side about 0·4 mm. high. The armature is very dense and



TEXT-FIG. 9.—*Nephthya mollis.* Polyp.

irregular ; the only more or less regular chevron arrangement to be seen is in the supporting bundle, which is of the ensheathing type and consists of about 5 pairs of bow-shaped thorny spindles, which curve round the back of the polyp and do not project. Average dimensions of these are 0·52 × 0·05 mm. So dense and irregular is the armature round the sides of the polyp that it is difficult to discover any exact plan of arrangement in the spicules. Thorny, curved spindles, about 0·2 mm. in length, slope on each side towards the supporting bundle; beyond these are about 8 pairs of spindles, smaller and less thorny, arranged in some polyps in a very irregular chevron, while the inner side of the polyp shows a mass of small scattered rodlets, the smallest quite smooth and as small as 0·02 mm., but the majority with low roughness and with an average length of 0·07 mm. and breadth of 0·02 mm. The tentacles are armed with transversely arranged double rows of similar but more slender rodlets. A few small scattered rodlets are also seen on the inner side of the polyp stalks.

In the cortex of the twigs are thorny spindles, varying very much in size. The largest measured was 0·8 mm. In the rind a little further down a branch are numerous shorter,

blunter spindles with slightly larger blunt warts. (Average dimensions 0·2 mm. × 0·03 mm.) In the lower half of the stem the cortex becomes firmer and rougher to the touch, and is filled with a dense mass of small variously shaped spicules, with a few spindles scattered amongst them. The spindles are mostly small and with rough, fairly blunt warts. Average length 0·25 mm. Common amongst the small spicules is a double-capstan-like form, with a short median waist and two terminal zones of blunt warts. There are also somewhat stellate types, and some showing a short warty base with jagged foliar thorns above. Some small quadriradiates are also seen. An average length of all these smaller forms is 0·08–0·1 mm. Nearer the base of the stem practically no spindles at all are found, only the dense felt-work of small spicules.

TEXT-FIG. 10.—*Nephthya mollis*, n. sp. Spicules.

The spicules of the canal walls are pointed spindles with rather few low simple warts (0·47 mm. in length); rough heavy spindles, with very large compound warts (up to 0·9 mm. × 0·2 mm.), also some large triradiates, and small irregular types with rather smooth projections (about 0·2 across). This species comes very near to *N. amboinensis*, Burchardt, in form of growth, small size of polyps, irregular spiculation of polyp and non-projecting supporting bundle, but the polyp-armature is somewhat different and the spiculation throughout shows decided differences, such as the presence of the very characteristic small capstan-like spicules, which form a dense mass in the stem cortex and which are not found at all in *N. amboinensis*.

LOCALITY: Low Isles, Detailed Survey II.

Genus *Dendronephthya*.

Bushy or tree-like Nephthyids with the polyps arranged in groups or bundles or singly. The polyps have a supporting bundle which generally projects far, giving the colony a spiny appearance. The canal walls are thin.

Dendronephthya bicolor (Wright and Studer).

Wright and Studer, Alcyonaria, "Challenger" Report, XXXI, 1889, p. 207, 2 figs.; Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. XXI, Syst., 1905, p. 665.

Several small colonies from Station IX, all growing on two types of bivalve shell, seem to be young forms of this species, described by Wright and Studer from a specimen from Torres Straits.

Kükenthal considered it to be synonymous with Wright and Studer's *Spongodes umbellata* from the same locality, but after examining Wright and Studer's specimens, I consider that the two forms are quite distinct species. The mode of branching in *S. umbellata* is much more definitely umbellate, and the colony is much softer and less spiny, the supporting bundles of the polyps being weaker and projecting less.

The colouring is identical with the type, grey-white trunk, branches and twigs, the polyp heads in the lower part of the colony with an armature of reddish spicules, but in the upper part of the colony with white spicules. The branching in such young colonies is more open and less compacted than in the type-specimen, but slight foliation is already to be seen in the lower twigs. The polyp has a very strong supporting bundle with a main projecting spindle up to 3·5 mm. in length; the polyps are very variable, but in general their sides are more strongly armed than the inner and outer surfaces. The most common armature of the sides is 4–5 pairs of spindles in chevron, with the topmost pair stronger than the remainder and projecting beyond the tip of the polyp. But polyps were found with up to 6 pairs of spindles at the sides and also others with only 2 pairs. The small tentacular spicules may be either red or white in polyps, with reddish armature.

The height of the largest colony, growing with four other smaller colonies on a bivalve shell, is 3·3 cm., and the maximum spread of the colony is 2·3 cm. The stem has a maximum diameter of 7 mm.

LOCALITY: Station IX. Dredge.

Previously described from Torres Straits.

Dendronephthya florida (Esper).

Esper, Pflanzenthiere, III (1788–1830), p. 49, Alcy., pl. xvi; Gray, Proc. Zool. Soc. London, 1862, p. 27, 4 figs.; Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. XXI, Syst., 1905, p. 651, 2 figs.; Alcyonaria, Kükenthal, Fauna Südwest-Australiens, III, 1910, p. 53, 1 fig.

Seven specimens along with some fragments from near Cape Kimberley are all incomplete, the much-branched polyparium present, but the stem missing. The general colouring of the branches is white with purple-red spindles. It deepens to purplish-red, due, on the twigs, to the greater numbers there of red spicules which give the colour to the colony. The spicules of the supporting bundle, the largest of which projects and may be up to 2·4 mm. in length, are also deep purplish-red, but the polyps and the polyp spicules are all dead white. The polyp armature consists of 8 points of up to 7 chevron rows of these small finely warted white spindles.

I have compared this specimen with those in the British Museum, and find that the mode of growth, which seems somewhat variable, agrees very closely with that of a colony

from the Philippines (see Gray, 1862, p. 27) and of one from Billiton Island, Philippines. The twigs in some parts of the colonies group together to form rather flat, close masses of adjacent polyp-bundles, but they may also grow in a more open type of growth, so that the individual bundles of polyps are clearly seen.

The largest of these incomplete colonies has a height of 4·4 cm. and a maximum spread of 3·5 cm.

LOCALITY: Dredge, ¼ mile S. of Cape Kimberley, 4 fathoms (shell gravel).

Previously recorded from Hong-Kong, Philippines, South-West Australia (Shark's Bay).

Dendronephthya heterocyathus (Wright and Studer).

Wright and Studer, "Challenger" Report, XXXI, 1889, p. 210, 2 figs.; Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. XXI, Syst., 1905, p. 693.

A small colony, 2·8 cm. in height and with a maximum diameter of 2·3 cm., from Station XII agrees very closely with Wright and Studer's "Challenger" specimen. The branching, already fully described, is of exactly the same type, and the colouring and spiculation are also similar. This species is made distinctive by the polyp armature and by the presence of numerous very small rods and spindles in the polyp stems and the upper twigs. The polyp armature consists of 8 points of numerous small white or flesh-coloured or pink spindles arranged often rather irregularly in chevroned rows. There may be up to 10 or 12 pairs of these small spindles in chevron with other even smaller ones arranged irregularly between the points, and in some cases a point may consist of 4 rows of irregularly but more or less horizontally arranged spindles with little sign of a chevron arrangement. In our specimen some of these small spindles are pinker than in the "Challenger" specimens, where they are white for the most part, only a few showing flesh-colour.

Kükenthal (1905, p. 694) stated that he believed that Wright and Studer's "Challenger" species, *D. heterocyathus*, *D. monticulosa* and *D. pustulosa*, might be all of the same species. I have examined their specimens of these three species, and have no doubt that Wright and Studer were right in considering them as quite separate. *D. monticulosa* and *D. pustulosa* strongly resemble each other in growth and colouring, but the polyp armature is quite distinct. In *D. monticulosa* the spicules of the points are much larger and less numerous (not more than 4 rather regularly arranged pairs to a point), with the topmost pair much larger and projecting well beyond the polyp head. The polyp armature of *D. pustulosa*, on the other hand, is more of the same type as in *D. heterocyathus*, with numerous very irregularly arranged pairs (up to about 7–9) of small spindles in each point. These spindles are, however, decidedly stouter and longer (up to 0·2–0·3 mm. long and up to 0·05 mm. broad) than in *D. heterocyathus*, where they are markedly small (up to 0·1–0·2 mm. long and up to 0·02–0·03 mm. broad). Another difference between these two species is that the polyp spicules in *D. pustulosa* are all a chalky white, which makes the polyp heads stand out in the colony as very clearly defined small white pustules, but in *D. heterocyathus* the polyp spicules are a less dead white or flesh-coloured and the polyp head has a rather dirty white or grey-cream colour.

LOCALITY: Station XII. Dredge.

Previously recorded from Torres Straits.

Dendronephthya nigrotincta (Ridley). (Plate V, fig. 5.)

Spongodes nigrotincta, Ridley, Alcyonaria of the Mergui Archipelago, J. Linn. Soc., Zool. XXI, 1888, p. 231, 4 figs.; Kükenthal, Versuch einer Revision der Alcyonarien, II, Teil 2, Zool. Jahrb. Syst. XXI, 1905, p. 668.

The original description of this species is not very complete, but so far as it goes it agrees fairly closely with a species of *Dendronephthya* from Station XXII. Unwilling as I am to add to the already unwieldy list of species in this genus, I shall refer our specimen tentatively to *D. nigrotincta*. The form of growth is very similar—a long stalk, with a rounded head made up of numerous small incipiently convex lobes, closely adjacent to each other. The stalk gives rise to a small number of short stout branches, which give rise, after only one or two divisions, to the terminal polyp-bearing twigs. Below the main

Text-fig. 11.—*Dendronephthya nigrotincta*. Polyp.

" head " two short polyp-bearing twigs are given off from the main stem. The stalk is much wrinkled longitudinally, and in the upper half, along with the branches, it shows marked transverse striation, noted by Ridley in his specimen. This transverse wrinkling in the stems of *Dendronephthya* is a rather unusual feature, partly dependent, as Ridley notes, on the rather rarely found transverse arrangement of the stalk spindles if they are present in numbers.

The armature of the polyp has not been described, save that Ridley mentions a projecting spindle of the zooids up to about 1 mm. in total length. Our specimen shows a polyp with a distinct, but not markedly strong, supporting bundle, with generally 2 or 3 strong, slightly twisted, thorny spindles, one of which may project for about 0·5 or 0·6 mm. The longest reached a total length of 1·3 mm. On the walls of the polyp are 8 very distinct points with marked grooves between (this agrees with Ridley's small-scale illustration). The wall of the polyp on the ventral side shows a good armature of thorny spindles in chevron (up to 5 pairs), though not quite so strong as on the dorsal

and lateral walls (up to 8 or 9 pairs). The polyp is borne at almost a right angle to the stalk.

In the branches the spicules of the cortex are delicate, twisted, thorny spindles.

In the cortex of the lower stem the spicules agree with Ridley's description in being very much branched types, some almost stellate, others more elongated. An average diameter is 0·13 mm.

The total height of the colony is 10 cm. ; the stem below the main branching into the polyparium is about 8 cm. in length, and has a maximum diameter of 1·3 cm. It gives off several stolons entangled with debris at the base. The convex polyparium is almost circular in outline, with a diameter of about 2·7 cm. The colour in spirit is dark reddish-brown, while all the spicules are colourless. This species in its mode of growth, its marked wrinkling of the stalk, its polyps with a weak supporting bundle and 8 such definite grooves between the points and the type of spiculation throughout the stem and branches approaches near to the genus *Umbellulifera*. The supporting bundle is sufficiently marked, however, to determine its inclusion into the genus *Dendronephthya*, but it must be certainly considered as a type illustrating a linkage between the two genera.

LOCALITY : Station XXII. Dredge.

Previously recorded from Mergui Archipelago.

Dendronephthya spinifera, Holm.

Holm, Beiträge zur Kenntniss der Alcyon. *Spongodes* Lesson, Zool. Jahrb. Syst. VIII, 1894, p. 38, 3 figs. Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. XXI, Syst., 1905, p. 567, 1 fig.

A large colony (General Survey, Low Isles, coral head on seaward slope of reef), growing in one plane, has a height of 20 cm. and a spread of 16 cm. The colouring is striking, with bundles of orange-yellow polyps on a creamy-grey background of twigs and branches, which, towards the base, are slightly tinged with ochre-yellow. Most characteristic is the very spinose appearance of the colony, due to the great development (up to 5 mm. long) of the main projecting spicule of the supporting bundle in the polyps. These large spicules are creamy-white tinted with ochre at the free tip. The polyps are grouped in bundles of up to 8, on the ends of short twigs, but towards the base of the colony the twigs are foliaceous and the polyps are arranged round the edge of flattened discs.

The armature of the polyps shows 4–6 pairs of spindles in chevron at the sides of the polyp. One of the topmost spindles in each chevron is generally considerably larger than the rest and projects beyond the top of the polyp. On the inner and outer sides of the polyp there are 2–4 pairs of chevroned spindles. The spiculation of the cortex of stem and branches is dense, with very large spindles arranged transversely across them. The largest measured had a length of 9 mm. The spicules from the cortex of the basal stem include rough warted spindles and smaller irregular forms, 3- or 4-rayed, or roughly stellate forms.

Another small fragment of a colony from the same station on the same date is exactly similar to the larger colony.

A small colony (from outer region, Batt Reef) grows in one plane to a height of 5·2 cm. and with a maximum spread of 8·7 cm. It agrees well with the other colonies,

but seems less well preserved. The branches and twigs are white except at the base of the main stem, which is very slightly tinged with yellow. The polyps are brownish except in two small patches, where they are orange-yellow.

A note from Prof. Stephenson states : " This specimen was cream, yellow and crimson during life. The species was fairly common on vertical, shaded, or overhanging surfaces below the level of low water ; we obtained it when diving."

LOCALITIES : General Survey, Low Isles, coral head on seaward slope of reef, 19th May, 1929.

Outer region Batt Reef, 27th September, 1928.

Previously recorded from Viti Island.

Genus *Stereonephthya*, Kükenthal.

Very rigid Nephthyids with the polyps arranged singly or in small groups (not definite bundles, as in *Dendronephthya*) on a stem that may be unbranched or give rise to a few main branches. The polyps have a strong supporting bundle.

Stereonephthya unicolor (Gray).

Spoggodes unicolor, Gray, Proc. Zool. Soc. London, 1862, p. 29, 2 figs. ; Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. Syst. XXI, 1905, p. 700, 2 figs.

A rather shrivelled colony from Station XXV ; has a height of 3 cm. and a maximum spread of 3·4 cm. It is bushy, with the branches in all directions, rigid and very brittle. On the twigs are borne the rather distant polyps, each with a strong supporting bundle, which projects slightly beyond the small polyp head and spreads round the sides of the polyp stalk. The armature of the polyp shows dorsally and at the sides thorny sloping spindles, as figured by Kükenthal (1905, p. 701, text-fig. J^2), while the inner side of the polyp and of the polyp-stalk show very numerous extremely small spicules scattered irregularly in the coenenchyma. The colour is a muddy grey. In the upper rind lie transversely arranged spindles up to 1·5 or 2 mm. long.

LOCALITY : Station XXV. Dredge.

Previously recorded from Bellona Reefs.

Family SIPHONOGORGIIDAE.

Genus *Nephthyigorgia*, Kükenthal.

Very strong Siphonogorgiids with branching in one plane. Stem, branches and twigs are thick and finger-shaped. Polyps arise singly from thickly arranged, projecting verrucae in more or less transverse rows on all but base of main stem. The cortex of stem and branches thickly filled with strong warted spindles, which give a roughened surface.

Nephthyigorgia annectens (Thomson and Simpson).

Thomson and Simpson, Alcyonarians, " Investigator ", 1909, Pt. II, p. 134, 2 figs. ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, pp. 153 and 166 ; ? *Nephthyigorgia pinnata*, Kükenthal, Alcyonaria, Fauna Südwest-Australiens, III, 1910, p. 65, 2 figs.

This distinctive species is represented in the collection by seven fine specimens. The largest, of four colonies from Station XII, shows the tendency to grow in one plane ; it

has a height of 11 cm., with a maximum spread of 11·5 cm. All show the typical stout, finger-like branches, covered closely with verrucae, and the deep red coloration of all the spicules. The general red colour of the colonies is somewhat masked in all the specimens by a coating of grey mud and debris.

Kükenthal (1910) created the genus *Nephthyigorgia* for three Australian species, one of which, *Nephthyigorgia pinnata*, seems to me undoubtedly to be synonymous with *Siphonogorgia annectens*, which should undoubtedly be referred to the newer genus on account of the distinctive mode of growth.

Localities : Station XII. Station XIX.

Previously recorded from Indian Ocean, Dutch East Indies, South-West Australia (?).

Family Fasciculariidae.

Genus *Studeriotes* (Thomson).

Colony with densely spiculose cup or involucre, into which retract numerous finger-like polyp-bearing lobes or branches. The lobes are thickly covered with polyps, which have a strong supporting bundle. Spicules all spindles except for some minute irregular forms from the canal walls.

Studeriotes semperi (Studer).

Kükenthal, Versuch einer Revision der Alcyonarien, II, Nephthyiden, Teil 2, Zool. Jahrb. Syst. XXI, 1905, p. 537, 1 fig. ; Alcyonaria, Fauna Südwest-Australiens, III, 1910, p. 69, 4 figs.

A colony dredged from Station XVI shows a branched polyparium expanded from the stiff, strongly spicular involucre, typical of this interesting family. The involucre is long, narrow and flattened, twisted to one side in the lower half and, as in a Pennatulid, terminating in a point with no flattened base of attachment, so that the colony must have stood half buried in sand or mud. Brownish traces, indeed, of a muddy deposit are to be seen on the surface, up to a height of about 5 cm., and the long curved spicules of the wall of the calyx up to that height stand out jaggedly from the surface, giving the roughened appearance common in spiculose Alcyonarian stems which have been growing in sand or mud.

The total height of the involucre is 8·4 cm., with a maximum flattened diameter of 2·2 cm. The total height of the polyparium, which is almost entirely expanded from within it, is 4·3 cm. The branches are up to 1·5 cm. in length, but their length must vary considerably according to the state of contraction or otherwise. The average breadth of a branch is about 4 mm. The polyps are arranged thickly on the branches and curve inwards on a short stalk ; they show a strong supporting bundle, of which 1 or 2 spindles may project slightly ; on the side of the polyps are up to 3 pairs of spindles in chevron, with 1 or 2 horizontal spindles beneath, rather irregularly placed, and on the inner side of the polyp the armature is weaker.

The twisted spindles on the wall of the involucre reach a length of 10 mm., as in one of Kükenthal's specimens (1905, p. 540).

The colour of the involucre and branches of the polyparium is stone-coloured and the polyps are a dark brown.

The shape of the involucre is more typical of *S. spinosa* than *S. semperi*, but the armature of the polyp and the supporting bundle (both more important features, I consider, from a systematic point of view) agree well with those of *S. semperi*.

LOCALITY: Station XVI. Dredge.

Previously recorded from Philippines, China, Formosa.

ORDER TELESTACEA.

Genus *Telesto*, Lamouroux.

From a network of basal stolons arise long axial polyps, from the walls of which grow lateral secondary polyps and from these tertiary polyps, and so on up to 5, till a shrub-like or tree-like growth results. The soft distal polyp-bodies are retractile within the hard-walled calices, which form the stem and branches of the colony. There is a definite development of horny substance within the polyp walls. There is no fleshy development in *Telesto*; the stem and branches are hard, narrow and stick-like. The spicules are rods with characteristic antler-like projections or warts; the spicules tend to fuse in the polyp-walls.

Telesto arborea, Wright and Studer.

Wright and Studer, Alcyonaria, "Challenger" Report, XXXI, 1889, p. 262, 2 figs.; Laackmann, Zur Kenntnis der Alcyonarien Gattung *Telesto*, Zool. Jahrb. 1908, Suppl. XI, p. 68, 2 figs.; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 212, 2 figs.

Several colonies from two stations show the characteristic thin-walled, deeply furrowed, upright stems of the species, with typical spiculation. They are all, however, young specimens, some unbranched, others slightly branched. One very young colony from ¼ mile south of Cape Kimberley, growing on a bivalve shell along with a colonial Tunicate, shows single polyps, from 0·5–2 mm. in height, connected with each other by flat stolons 1–2 mm. in breadth. One polyp 9 mm. high with grooving distinct near the tip shows 5 secondary buds, developed on four sides. Another young colony from the same locality has grown on the broken stem of a specimen of *Echinogorgia*.

LOCALITIES: Quarter of a mile south of Cape Kimberley, 4 fathoms, shell gravel. Dredge.

Station XII. Dredge.

Previously recorded from Arafura Sea, Zanzibar, Amboina, Dutch East Indies, Sydney.

Telesto rubra, Hickson.

Hickson, Alcyonaria of the Maldives, 1903, p. 480, 6 figs.; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 214, 8 figs.

A very young colony from Station IX growing on a stone shows several axial polyps united together by their stolons, which are up to 1 mm. in breadth. The axial polyps vary from very young stages under 1 mm. high, to polyps 1·5 cm. high with 3 or 4 secondary polyps. All show slight longitudinal furrows, more marked near the mouth.

The colour is pinkish red, as are the spicules, compactly fused warty spindles. As in very young specimens from the "Siboga" Expedition, the fusion of the spicules is already strongly marked. There is a possibility of young stages of *T. rubra* being regarded as *T. rigida*, Wr. and Studer, also reddish in colour. We have examined the type-specimen of *T. rigida*, however, and the absence of longitudinal furrows and a difference in the spiculation make it quite distinct.

Fragments of a fully developed colony from Station XII are typical of the species.

Localities : Station IX. Dredge.

Station XII. Dredge.

Previously recorded from Maldives, Rutland Islands, Andamans, Ceylon, Dutch East Indies.

Order GORGONACEA.

Sub-order SCLERAXONIA.

Family Briareidae.

Genus *Solenopodium*, Kükenthal.

Briareid colony flat and encrusting, sometimes with simply branched stem-like upgrowths, which are hollow save at the tips, where they may have a solid axis. Both base and stems show a softer outer layer and hard inner layer of densely packed spicules (warted zoned spindles, triradiates and irregular forms), and a horny substance is present in this "Markschicht". The small polyps are found on the outer surface of the base and stems ; they are almost spiculeless. The spicules and the general appearance of the outer layer are colourless, of the inner layer purplish-red.

Solenopodium stechei (Kükenthal).

Kükenthal, Gorgonaria, Deutsch. Tiefsee-Exped. XIII, 1919, p. 38, 9 figs.

A small piece of an encrusting species, about 6 cm. long and 4 cm. broad, seems to me to agree well with Kükenthal's description of *Solenopodium stechei*. This species develops hollow upgrowths from encrusting basal masses, and early stages of such growths are found in four low humps, one of which, cut through, shows a hollow centre. The base of the encrusting membrane, also continued into the inner surface of the hollow upgrowths, is deep purple red, while the upper rind and the polyps are whitish yellow. The depth of the encrusting membrane is 3 mm. altogether, often less. The white upper part is about 2·3 mm. thick. Some of the 8-rayed flat inconspicuous little polyp-calices are tinged with purple-red. The polyps in this specimen are about 1 mm. apart, and more closely crowded than in Kükenthal's, where they were 2–3 mm. apart. This, however, is a very variable character, if one considers colonies of *Briareum asbestinum*, young encrusting stages of which our specimen closely resembles. In that species the polyps may be nearly touching each other or 3 mm. apart.

The spiculation agrees very closely with Kükenthal's description and figures. In

the polyp are small rather rod-like spicules, with a few warts. They are grouped in our specimen near the base of the polyp and are about 0·1 mm. long. In the calix lie longitudinally arranged spindles, larger and coarser than the polyp spicules, up to 0·4 mm. in length. In the rind are large spindles, up to 0·6 mm., blunt-ended or pointed, with warts arranged in zones. There are also triradiates and irregularly branched spindles. In the outermost layer of the rind are smaller warty spindles, 0·15–0·2 mm. long. The spicules of the basal "Markschicht" are all purple-red in colour and the spicules are mostly more slender jagged and branched. They are bound quite firmly together with a distinct horny substance.

The systematic position of this genus has already been discussed.

Locality : General Survey of Low Isles.

Previously recorded from Banda (Mollucas).

Genus *Iciligorgia*, Duchassaing.

"Central spicular axis dense, imperforate. Longitudinal canals forming a circum-axial zone. Erect, branched ; stem and branches antero-laterally compressed, with knife-like lateral edges. Zooids wholly retractile, arranged in a single series along each edge of the branches ; no external verrucae" (Ridley, 1884, p. 351).

The species and true definition of this genus are doubtful, as the original description is very incomplete. Kükenthal creates a new genus for *I. orientalis*, but I am not convinced as to the validity of this, and in the meantime retain *I. orientalis* in the genus to which Ridley assigned it.

Iciligorgia orientalis, Ridley.

Ridley, Zoological Collections of the "Alert", 1884, p. 351, 3 figs. ; Thomson and Dean, Alcyonacea of the Siboga Exped., Monogr. XIII*d*, 1931, p. 190 ; Broch, Svenska Akad. Handl. LII, 1916, 11, p. 22, 5 figs. ; Kükenthal, Das Thierreich, 1924, p. 18, 1 fig.

Two fragments, blue-grey in colour, from Station XXI are typical of the species, the knife-like edges of the branches in which the polyps lie being especially characteristic. One, 13 cm. in height and with a maximum stem diameter of 5 mm., is a broken-off terminal branch with branchlets ; the other, 18 cm. in height with a maximum stem diameter of 1·3 cm., is the lower portion of a colony, the base of which has grown over a hollow tube (probably of some worm ?). Owing to this basal overgrowth with the central hollow worm-tube, it is impossible without seriously damaging the specimen to find if there are nutrient canals present in the medulla of the stem—a point disputed by Thomson and Dean, 1931. The spicules agree entirely with the description by Ridley.

Locality : Station XXI. Dredge.

Previously recorded from Torres Straits, Dutch East Indies, North-West Australia.

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5. INDEX.

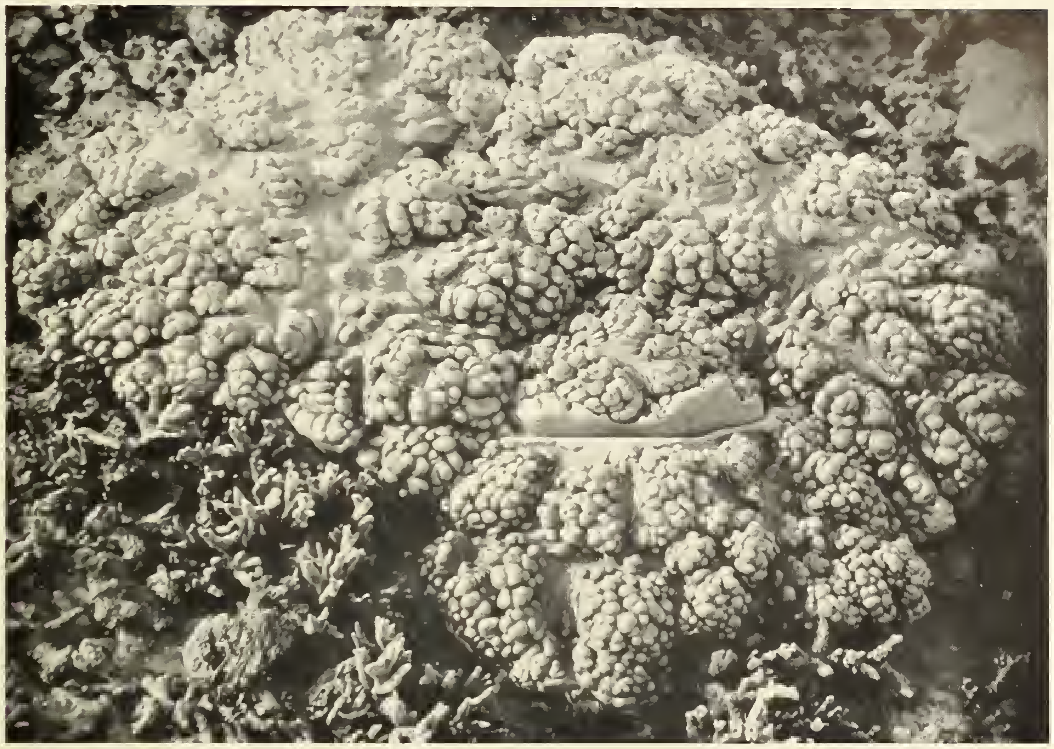
EXPLANATION OF PLATES.

(Plates I, II and III photographed by Dr. Manton from living colonies at Barrier Reef.)

DESCRIPTION OF PLATE I.

Sinularia polydactyla (Ehrb.).

Fig. 1.—Contracted in air at low tide.
Fig. 2.—Polyps contracted, branches expanded.
Fig. 3.—Above, polyps expanded ; below, polyps and branches contracted.



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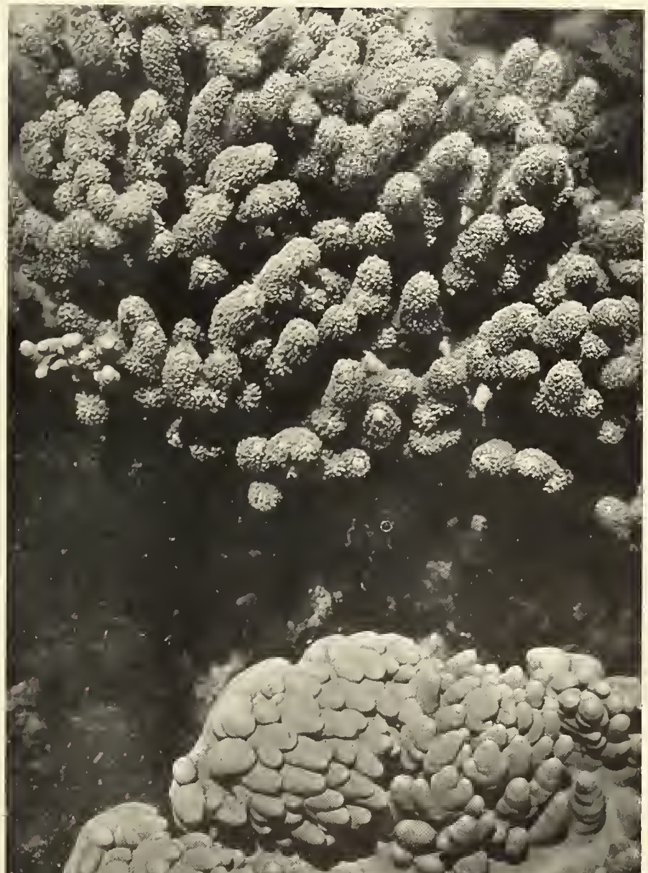

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DESCRIPTION OF PLATE II.

FIG. 1.—*Sinularia conferta* (Dana), n. var. *gracilis*. Polyps contracted.
FIG. 2.—*Sinularia lochmodes*, Kolonko.

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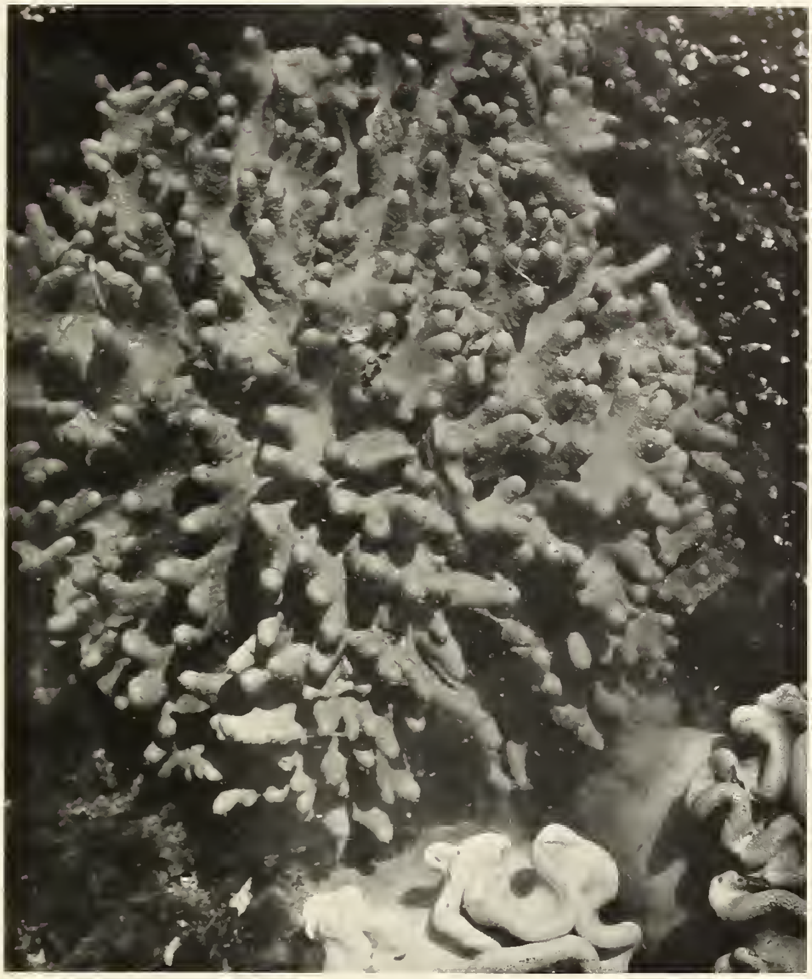
DESCRIPTION OF PLATE III.

Fig. 1.—*Lobophytum pauciflorum* (Ehrb.). Polyps contracted.
Fig. 2.—*Microspicularia pachyclados* (Klunz.). Polyps expanded (right), contracted (left).



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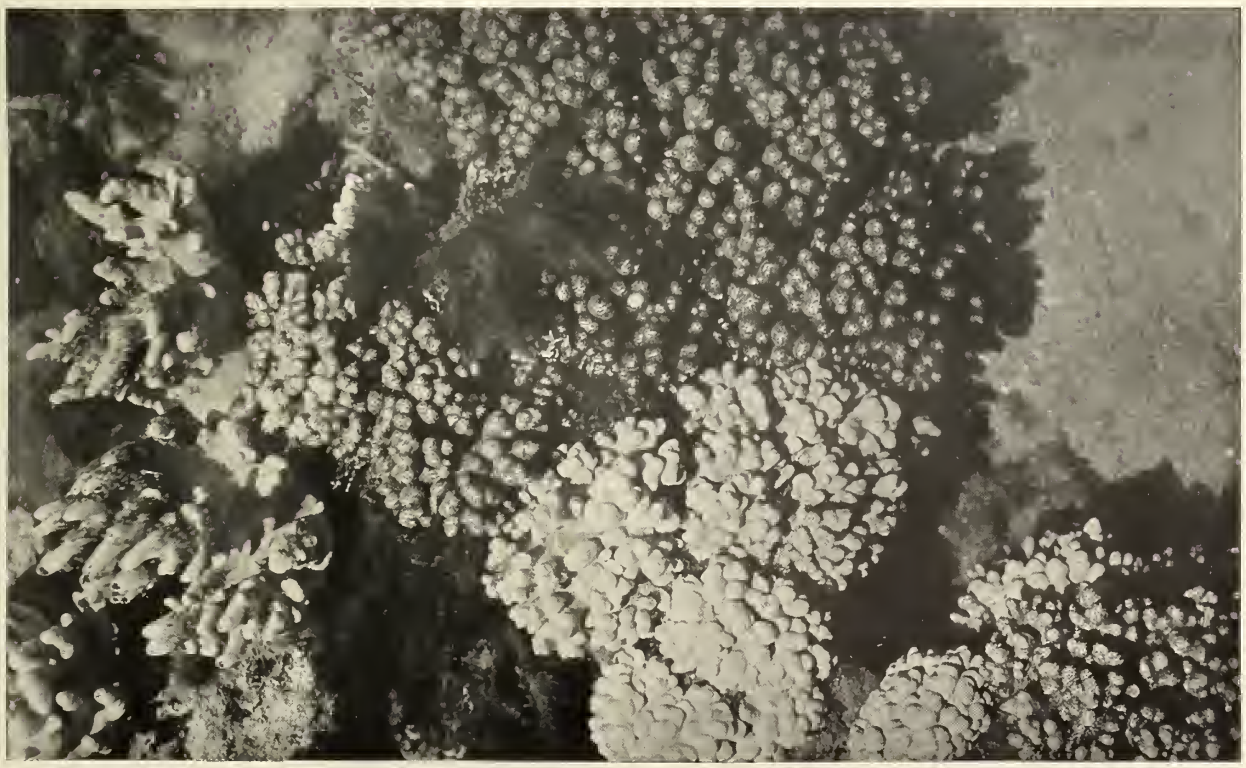

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NATURAL HISTORY

DESCRIPTION OF PLATE IV.

Fig. 1.—*Paralemnalia digitiformis*, n. sp. Escape Reef. × 1.
Fig. 2.—*Paralemnalia digitiformis*, n. sp. Reverse side. × 1.
Fig. 3.—*Paralemnalia digitiformis*, n. sp. Undina Reef. × 1.
Fig. 4.—*Alcyonium australe*, n. sp. × 1.
Fig. 5.—*Capnella lacertiliensis*, n. sp. × 1.
Fig. 6.—*Sinularia robusta*, n. sp. × 1.
Fig. 7.—*Cespitularia erecta*, n. sp. × 1.

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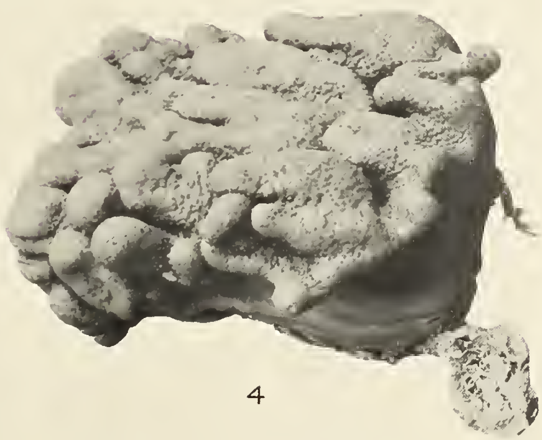

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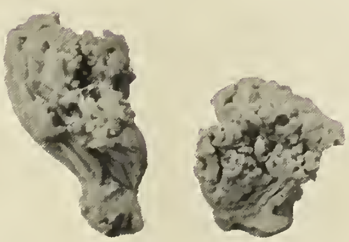

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DESCRIPTION OF PLATE V.

FIG. 1.—*Sinularia robusta*, n. sp. Lizard Island. × 1.
FIG. 2.—*Sinularia gardineri* (Pratt). × 1.
FIG. 3.—*Sinularia robusta*, n. sp. Type. × 1.
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FIG. 5.—*Dendronephthya nigrotincta* (Ridley). × 1.
FIG. 6.—*Nephthya mollis*, n. sp. × 1.

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NATURAL HISTORY

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME V, No. 3

COPEPODA

BY

G. P. FARRAN, B.A.

Department of Agriculture (Fisheries Branch), Dublin.

WITH THIRTY TEXT-FIGURES

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BRITISH MUSEUM Z D NATURAL HISTORY

3 JUL 1936 PRESENTED

COPEPODA

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WITH THIRTY TEXT-FIGURES.

In the present paper the Pelagic Copepoda taken during the Great Barrier Reef Expedition are treated of from a systematic standpoint, with only brief references to their habitat, relative abundance, and seasonal and vertical distribution, since it is proposed that these latter points should be dealt with more fully in a separate paper.

The material examined consisted of samples from about 70 stations, the majority of the samples being from townettings taken weekly inside the reef from July, 1928, to July, 1929, at a fixed position, 3 miles east of the Laboratory on Low Island, referred to subsequently as 3 mi. E., where the depth was 32 metres, oblique hauls being made with both stramin and finer meshed nets from near the bottom to the surface. A few hauls were made further to seaward, usually at greater depths, in the channels running through the reef, viz. Trinity Opening, Stn. 8, 45 m., Stn. 11, 61 m., and Stn. 26, 57 m.; off Cape Bedford, Stn. 43, 30 m.; off Lizard Island, Stn. 44, 31 m.; Cook's Passage, Stn. 46, 33 m.; and Papuan Pass, Stn. 49, 46 m. Two stations were made just beyond the edge of the reef, Stn. 19, 225 m., and Stn. 29, 205 m., and in the deep water outside the reef were Stn. 50, in more than 400 m., and Stns. 20, 28 and 45, in more than 600 m.

The nets used in making the collection were mainly of two grades, stramin and coarse silk, 58 strands to the inch. A net of 1 metre square of coarse silk with 40 meshes to the inch was used on a few occasions for vertical hauls. It has not been thought necessary to specify in every case with what nets the specimens were taken, but in some instances the abbreviations S. = stramin net, C. = coarse silk net, international pattern, N. = coarse silk Nansen net, and 1 m. C. = coarse silk, 1 metre square, have been used.

On the stations at 3 mi. E. and in the reef passages oblique hauls were made with both stramin and coarse silk nets. On the deeper stations outside the reef these nets were used for vertical hauls. A full description of the nets and methods of collection and a detailed list of stations are given in Vol. II, No. 2 of this series of reports, but for the purposes of the present paper it will be sufficient to give particulars of the stations which were not situated at 3 mi. E.:

Station Number.	Date.	Position.	Depth in metres.
8	24th Aug., 1928	16° 30′ S. 145° 52′ E. (in Trinity Opening)	45
11	6th Sept., 1928	16° 24′ S. 145° 52′ E. (in Trinity Opening)	61
19	20th Oct., 1928	16° 20′ S. 146° 3′ E. (outside Trinity Opening)	225
20	,, ,,	16° 19′ S. 146° 7′ E.	>600
26	19th Nov., 1928	16° 24′ S. 145° 53½′ E. (in Trinity Opening)	57
28	23rd Nov., 1928	16° 19′ S. 146° 5′ E. (outside Trinity Opening)	>600
29	24th Nov., 1928	16° 17′ S. 146° 2′ E.	*ca.* 200
43	26th Feb., 1929	15° 16′ S. 144° 26½′ E. (off Cape Bedford)	30
44	27th Feb., 1929	14° 44′ S. 145° 27½′ E. (off Lizard Island)	31
45	28th Feb., 1929	14° 31′ S. 145° 35′ E. (outside Cook's Passage)	>600
46	,, ,,	14° 32′ S. 145° 32′ E. (inside Cook's Passage)	33
49	17th Mar., 1929	15° 47′ S. 145° 47′ E. (inside Papuan Pass)	46
50	18th Mar., 1929	,, ,, (outside Papuan Pass)	>400

The following report, it should be understood, refers for the most part to small samples from the townettings, not to the total gatherings. For the first 14 stations, Stn. 1–14, these samples contained both large and small species. For the remainder of the stations on the reef only the large species were sampled, except for the serial townettings on Stns. 62, 65 and 68, which were examined in their entirety. The whole contents of the gatherings made outside the reef were examined, except that from Stn. 45, 1 m. stramin, 500–0 m., the container of which was broken in transit, most of the contents being lost.

No attempt has been made to provide a synonymy, but a reference is given under each species to some reliable figure and description, to prevent any doubt as to the species referred to.

The total number of species here recorded in 193 ; made up of—

Calanoida	127 species.
Harpacticoida	6 ,,
Cyclopoida	60 ,,
Total . . .	193 species.

These species fall into three groups : (1) The reef forms, which have their centre of distribution in the shore waters of low salinity, though also often found outside the reef. (2) The open sea epiplankton. (3) The deep water fauna.

The first group has probably been fairly completely sampled, as gatherings were made systematically throughout the year at the station at 3 mi. E. The second group will no doubt receive large additions from future collecting, as most of the records from outside the reef came from vertical hauls, made from a considerable depth, which only sampled the upper waters in passing. The third group is also clearly incomplete, as its area was only sampled on six stations outside the reef, with thirteen hauls, the deepest not going below 600 m. ; and although these stations furnish 74 species, omitting those known to be epiplanktonic, this number is only a small proportion of the general deep-water fauna, most species of which have a world-wide distribution.

The following is a list of the species taken, assigned as far as possible to these three groups. In some cases these assignments are necessarily provisional and in others arbitrary, the boundaries between the three classes not being always clearly defined. Species described as new, numbering 14 (and one variety), are given in heavy type.

LIST OF SPECIES.

CALANOIDA.

Coastal.

Calanus pauper
Undinula vulgaris
Eucalanus subcrassus
Paracalanus aculeatus
,, parvus
Acrocalanus gibber
Clausocalanus arcuicornis
Calocalanus pavoninus, n. sp.
Undinopsis tropicus
Euchaeta concinna
Scolecithrix danae
Centropages furcatus
,, gracilis
,, orsinii
Temora discaudata
Candacia aethiopica
,, discaudata
Calanopia elliptica
Labidocera acutifrons
,, acuta
,, laevidentata
,, sp. ?
,, detruncata
Pontella cristata
,, fera
,, danae
Pontellopsis regalis
,, krameri
,, macronyx
Acartia pacifica
Tortanus gracilis

Open sea.

Calanus tenuicornis
,, minor
,, gracilis
Undinula darwini
Eucalanus elongatus
,, attenuatus
,, mucronatus
,, crassus
Rhincalanus cornutus
,, nasutus
Mecynocera clausi
Paracalanus denudatus
Acrocalanus longicornis
,, gracilis
,, monachus
Clausocalanus furcatus
,, farrani
,, paululus
Calocalanus pavo
,, styliremis
,, contractus
,, plumulosus
Ctenocalanus vanus
Tanyrhinus naso, n. g. and n. sp.
Aetideus armatus
Euaetideus acutus
,, giesbrechti
Euchaeta longicornis
,, media
Euchaeta consimilis, n. sp.
Euchaeta wolfendeni
Euchaeta russelli, n. sp.
Scolecithrix bradyi
Centropages calaninus
Temora turbinata
Lucicutia flavicornis
,, gemina
,, clausi
,, ovalis
Heterorhabdus papilliger
Haloptilus spiniceps
,, acutifrons
,, mucronatus
,, longicornis
Euaugaptilus palumboi
Candacia curta
,, bispinosa
,, simplex
,, truncata
,, catula
,, longimana
Calanopia aurivillii
Labidocera minuta

Deep water.

Spinocalanus abyssalis
Chiridius gracilis
Pseudotharybis zetlandica
Gaetanus miles
,, pileatus
,, minor
Undeuchaeta plumosa
Xanthocalanus squamatus, n. sp.
Racovitzanus antarcticus
Scolecithrix ctenopus
Scolecithricella dentata
,, ovata
,, profunda
,, vittata
,, tenuiserrata
,, nicobarica
Scaphocalanus echinatus
Lophothrix latipes
Scottocalanus longispinus
Scottocalanus sedatus, n. sp.
,, **australis,** n. sp.
Scolecocalanus galeatus, n. g. and n. sp.
,, **lobatus,** n. sp.
Macandrewella asymmetrica, n. sp.
,, **sewelli,** n. sp.
,, **mera,** n. sp.
Temoropia mayumbaensis
Metridia venusta
Pleuromamma abdominalis
,, xiphias
,, gracilis
,, piseki
Heterorhabdus spinifrons
Haloptilus angusticeps
Augaptilus longicaudatus
,, spinifrons
Euaugaptilus filigerus

CALANOIDA.

Coastal.	Open sea.	Deep water.
	Pontella securifer	
	Pontellina plumata	
	Acartia pietschmanni	
	Acartia australis, n. sp.	
	Acartia danae	
	,, negligens	

HARPACTICOIDA.

Coastal.	Open sea.	Deep water.
Clytemnestra scutellata	Clytemnestra rostrata	Aegisthus mucronatus
Euterpina acutifrons	Setella gracilis	
	Microsetella norvegica	

CYCLOPOIDA.

Coastal.	Open sea.	Deep water.
Oithona similis	Oithona plumifera	Mormonilla phasma
,, rigida	,, tenuis	,, minor
Oncaea clevei	,, setigera	Pontoeciella abyssicola
Corycaeus speciosus	,, robusta	Conaea rapax
,, lubbocki	,, attenuata	Lubbockia aculeata
,, erythraeus	Oncaea venusta	,, squillimana
,, asiaticus	,, mediterranea	Pachysoma tuberosum
,, andrewsi	,, media	**Corissa parva,** n. g. and n. sp.
,, subtilis	,, ornata	
,, agilis	,, conifera	
,, catus	,, conifera var. **furcula,** nov.	
Corycella gibbula	Sapphirina metallina	
,, concinna	,, angusta	
Saphirella tropica	,, bicuspidata	
	,, scarlata	
	,, nigromaculata	
	,, stellata	
	,, auronitens	
	,, opalina	
	,, iris	
	,, ovatolanceolata	
	Copilia vitrea	
	,, mirabilis	
	,, quadrata	
	,, lata	
	Corycaeus crassiusculus	
	,, vitreus	
	,, robustus	
	,, typicus	
	,, flaccus	
	,, limbatus	
	,, longistylis	
	,, lautus	
	,, furcifer	
	,, minimus	
	,, pumilus	
	,, pacificus	
	Corycella carinata	
	,, curta	

NOTES ON SPECIES.

Calanoida.

Calanus tenuicornis, Dana.

Giesbrecht, 1892.

Occurrence.—Not taken inside the reef or in the reef passages. Common outside the reef on Stns. 19 and 20, scarcer on Stns. 28 and 45, not found on Stn. 50.

Length : ♀, 1·78–1·84 mm.

Calanus minor (Claus).

Giesbrecht, 1892.

Occurrence.—Occurred only occasionally, usually singly, inside the reef, but regularly in small numbers on the stations outside over deep water.

Length : ♀, 1·50–1·80 mm. ; ♂, 1·48–1·52 mm. The most frequent size of female was about 1·7 mm. Few males were found.

Calanus pauper, Giesbr.

Giesbrecht, 1892.

Occurrence.—Judging by the samples from which small species were available in their true proportions, this species was very plentiful inside the reef. It occurred all through the year. In townettings taken outside the reef it was very scarce.

Length : ♀, 1·38–1·68 mm. ; ♂, 1·35–1·52 mm.

Remarks.—Only two females with attached spermatophores were found, both on Stn. 55, 26th April, 1929, and in each case the spermatophore was attached to the right side of the cephalothorax, a little anterior to the middle, in a position in which it seemed impossible for it to function.

Calanus gracilis, Dana.

Giesbrecht, 1892.

Occurrence.—With the exception of one immature specimen in the reef passage, Stn. 11, all the examples were from outside the reef, where it occurred on Stns. 19, 20, 28 and 50 in small numbers.

Length : ♀, 2·48–2·95 mm. ; ♂, 2·65 mm.

Undinula vulgaris (Dana).

Calanus vulgaris, Giesbrecht, 1892.

Occurrence.—One of the most plentiful species in the collections from inside the reef, with a maximum from August to November, and a minimum in March. Females with attached spermatophores were taken from August to February and from May (few) to July, and adult males in every month. The number of females carrying spermatophores often reached 50% of the females present, and the males frequently were equal in numbers to the females. Outside the reef it was very scarce.

Length : ♀, 2·40–3·05 mm. ; ♂, 2·25–2·50 mm.

Undinula darwini (Lubb.).

Calanus darwinii, Giesbrecht, 1892.

Occurrence.—Like *Calanus minor*, this species only occurred very occasionally inside the reef, being taken on five stations between 31st August and 15th October. Three of these stations also yielded *Calanus minor*, which suggests that an influx of oceanic water had occurred. It was also taken in small numbers on three stations, 19, 20 and 45, outside the reef. This is probably its normal habitat.

Length : ♀, 2·16–2·20 mm.

Eucalanus elongatus (Dana).

Giesbrecht, 1892.

Occurrence.—Taken in very small numbers on most of the stations over deep water, Nos. 20, 28, 45 and 50 ; never inside the reef.

Eucalanus attenuatus (Dana).

Giesbrecht, 1892.

Occurrence.—A few were taken from time to time, usually singly, on the stations inside the reef. It also occurred in small numbers on all the stations at the edge of the reef and over deep water. It is evidently an oceanic species, like *E. elongatus*, but much more numerous.

Eucalanus mucronatus, Giesbr.

Giesbrecht, 1892.

Occurrence.—Rarely taken inside the reef, but regularly present in small numbers on the stations outside the reef.

Eucalanus crassus, Giesbr.

Giesbrecht, 1892.

Occurrence.—Very rarely taken inside the reef, on Stations 18, 35, 42, 43 and 44. Found in small numbers on all the stations outside the reef.

Eucalanus subcrassus, Giesbr.

Giesbrecht, 1892.

Occurrence.—Inside the reef this was, next to *Undinula vulgaris*, the most plentiful of the larger species. It occurred throughout the year on the stations at 3 mi. E., but in September, October and November, the months of maximum salinity on the reef, it became very scarce. Outside the reef it was very scarce, though usually present.

Length : ♀, 1·84–2·92 mm. ; ♂, 1·68–2·70 mm.

Remarks.—Females, apparently fully mature and with functional spermathecae, measured from 1·84–2·92 mm. in length ; one with an attached spermatophore measured 2·04 mm. Males fully developed measured 1·68–2·70 mm. Immature females apparently in stage V were found as large as 2·36 mm. and males similarly undeveloped up to 2·43 mm. The appendages of these specimens in stage V are, in the female, identical in jointing and setae with those in stage VI, but they are slightly less strongly chitinized, and the abdomen lacks the characteristic form of the adult, the genital segment being

less swollen. In the male in stage V the rigid form of the body found in the adult and the thickened first joint of the antennules are lacking; the thorax does not show the projecting lateral margin of the third segment and is without the lateral setae which are found on the third and fourth segments of the adult; the fifth feet show signs of immaturity in the shorter joints, with more rounded contours than in the adult. Seymour Sewell (1929) has given an account of the development of this species, but, probably because all his specimens represented a single brood taken on one station, the range of sizes found by him was comparatively small. viz. ♀. V 1·5–1·8 mm., ♀ VI, 1·9–2·1 mm., ♂ V, 1·35–1·5 mm., ♂ VI, 1·55–1·8 mm.

Rhincalanus cornutus (Dana).

Giesbrecht, 1892.

Occurrence.—Taken only three times at 3 mi. E., once in February and twice in May, but occurred regularly in small or moderate numbers both on Stns. 19 and 29 just outside the reef and also on the stations over deep water.

Rhincalanus nasutus, Giesbr.

Giesbrecht, 1892.

Occurrence.—Never taken inside the reef, in the reef passages nor on Stns. 19 and 29 just outside the reef. Present on all the stations over very deep water, but in very small numbers.

Mecynocera clausi, Thompson.

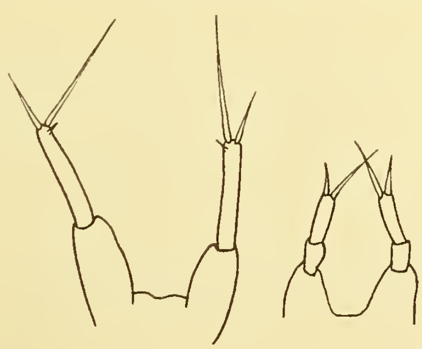
Giesbrecht, 1892.

Occurrence.—Occurred occasionally in the samples of small species preserved from inside the reef and the reef passages. Found regularly at the edge of the reef and over deep water, except on Stn. 29, from which only stramin townettings were available.

Paracalanus aculeatus, Giesbr. (Text-fig. 1.)

Giesbrecht, 1892.

Occurrence.—This is probably the most abundant species in the collections made at 3 mi. E., occurring in large numbers in all the fine-meshed nets from which samples



Text-fig. 1.—*Paracalanus aculeatus*. Female: *a*, fifth feet, × 400. *Paracalanus denudatus*. Female: *b*, fifth feet, × 400.

of the smaller species were available, and occasionally also amongst the larger species and in the stramin net gatherings. A large range of sizes was met with amongst the females from 3 mi. E. On Stns. 1–10 (27th July to 4th September) the range was from ·90–1·10 mm. with a maximum between ·96 and 1·02 mm., but from 5th September onwards only specimens between ·78 and ·90 mm. were found, and not till Stn. 61 (14th June) were specimens above ·9 mm. again seen.

Outside the reef, in the deep-water hauls, a few specimens of the typical reef form of *P. aculeatus* were taken, mostly of large size, ·96–1·23 mm.

The fifth feet of the female (Text-fig. 1, *a*) closely resembled those figured by Seymour Sewell (1929) for his *P. aculeatus* forma *major*.

Paracalanus denudatus, Sewell. (Text-fig. 1.)

Sewell, 1929.

Occurrence.—In hauls outside the reef.

Remarks.—Most of the specimens of *Paracalanus* of the *aculeatus* section taken in the hauls outside the reef were of a small size, ·73–·96 mm., and slender form, closely resembling *P. denudatus*, with which I provisionally identify them, and with which they agreed in the jointing of the antennules, the last joint of which was almost as long as the two preceding joints taken together. They differed from *P. denudatus* in their larger size and in having slightly shorter terminal spines on the exopodites of the swimming-feet, the proportions of the terminal joint to the end spine being in the case of the second, third and fourth feet respectively 100 to 128, 100 to 104 and 100 to 85. These figures are nearer to those given by Seymour Sewell (1929) for *P. aculeatus* than to those for *P. denudatus*. The armature on the face of the swimming-feet is greatly reduced, consisting of a few fine spinules on the endopodites and a transverse row of four fine spinules on the first joint of the exopodite of the second foot. The spinulation of the outer edge of the third joint of the exopodites is reduced to 6–7 fine spines on the second foot, 8–11 on the third foot and none on the fourth foot. The fifth feet (Text-fig. 1, *b*) are 3-jointed, sometimes 2-jointed, and small in comparison with those of *P. aculeatus*. The furcal rami are a little longer and narrower and closer together than in *P. aculeatus*.

Paracalanus parvus (Cls.).

Sars, 1903.

Occurrence.—Frequent inside the reef, but not nearly as common as *P. aculeatus*. Outside the reef it occurred in very small numbers in most of the townettings, but, owing to its small size, the collections probably do not indicate its true numbers.

Length : ♀, ·72–·90 mm.

Acrocalanus longicornis, Giesbr.

Giesbrecht, 1892.

Occurrence.—Taken occasionally at 3 mi. E., either singly or in small numbers. Occurred more regularly outside the reef, but was always scarce.

Length : ♀, 1·24–1·44 mm.

Acrocalanus gibber, Giesbr.

Giesbrecht, 1892.

Occurrence.—More numerous than *A. longicornis* at 3 mi. E., though never common, but scarcer than that species on the stations outside the reef.

Length : ♀, 1·02–1·15 mm.

Acrocalanus gracilis, Giesbr.

Giesbrecht, 1892.

Occurrence.—Found more often than *A. longicornis* at 3 mi. E., but not so often as *A. gibber*. On the stations outside the reef it was usually present in small numbers.

Length : ♀, 1·20–1·30 mm.

Remarks.—Occasionally female specimens were found with a minute unjointed fifth foot.

Acrocalanus monachus, Giesbr.

Giesbrecht, 1892.

Occurrence.—Taken only three times at 3 mi. E., but rather more numerous than *A. gracilis* on the stations outside the reef.

Length : ♀, ·92–·96 mm.

Clausocalanus furcatus (Brady).

Giesbrecht, 1892.

Occurrence.—Occurred frequently, but always in very small numbers, on the stations at 3 mi. E. Moderate or common on most of the stations outside the reef.

Length : ♀, 1·00–1·19 mm.

Clausocalanus farrani, Sewell.

Sewell, 1929.

Occurrence.—Only occurred outside the reef, where it was very scarce except on Stn. 19, on which 32 specimens were found. This suggests that its habitat is sub-oceanic.

Length : ♀, 1·09–1·22 mm.

Remarks.—This species was recently described by Seymour Sewell (1929) from the "Investigator" collections in the Indian Ocean. The specimens here recorded are slightly larger than those of the original description, but in other respects the resemblance is very close. The flattened outline of the forehead, with rostral points directed straight downwards, serves to indicate the species without examination of the appendages. The fifth feet, as in the type, and also in *C. arcuicornis* forma *minor* Sewell, are comparatively long and have divergently-forked tips, finely serrated on the inside of the forks. The serrations in my specimens are so minute that they cannot be seen except under very high magnification.

Clausocalanus paululus, Farran.

Farran, 1926.

Occurrence.—Taken outside the reef only, on three out of six stations. Considering its very small size the species must have been fairly common, as probably most of the specimens went through the meshes of the net.

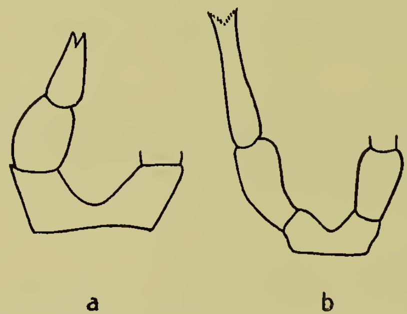
Length : ♀, ·72–·75 mm.

Remarks.—These specimens agreed in size and proportions and in the form of the fifth feet with those originally described from the Bay of Biscay (Farran, 1926). One specimen carried, attached to its genital segment, a bunch of three spermatophores measuring from ·144–·168 mm. in length.

Clausocalanus arcuicornis (Dana). (Text-fig. 2.)

Giesbrecht, 1892.

Occurrence.—The larger form only occurred once inside the reef, on Stn. 13, but was found in small numbers on all the stations outside. The common form inside the



Text-fig. 2.—*Clausocalanus arcuicornis.* Female, fifth feet, × 285. *a*, of large form ; *b*, of small form.

reef was the smaller one, which was found in small numbers on almost all the stations from which small specimens were available. It was occasionally observed outside the reef in company with the larger form.

Remarks.—The specimens which are here included under this name fall into two distinct size groups as regards the females, the larger measuring 1·38–1·62 mm., the smaller 1·08–1·28 mm. The larger specimens are the more robust and have a shorter abdomen, which is contained from 3·7 to 4 times in the length of the cephalothorax. The cephalon is rounded and the rostrum bent slightly backwards. The fifth feet (Text-fig. 2, *a*) are similar to those of the large (1·6 mm.) Atlantic form.

The smaller have a proportionally longer abdomen, contained 2·5 to 2·7 times in the length of the cephalothorax. The cephalon is rounded and the rostrum bent slightly backwards, as in the larger form, but the fifth feet (Text-fig. 2, *b*) are markedly different, resembling closely Sewell's (1929) figure of the fifth feet of *Clausocalanus arcuicornis* forma *minor*. At first sight the smaller form has some resemblance to *Clausocalanus pergens*, which it resembles in the proportions of cephalothorax and abdomen, but it differs in its larger size and in its fifth feet, which end in a divergent fork with fine denticulations on its inner margin. The fifth feet of *C. pergens* end in two closely-set points.

It is not possible to correlate these two size groups with the two forms *major* and *minor* which Sewell has described from the Indian Ocean. In them the abdomen of the larger form is proportionately considerably longer than that of the smaller. Here the reverse is the case. It may be noted that Sewell's figure, but not his description, of the form *minor* agrees fairly well with the smaller Barrier Reef form. In the figure the abdomen is shown as contained about 2·7 times in the length of the anterior division, but in the description it is said to be 3·17 times.

Calocalanus pavo (Dana).

Giesbrecht, 1892.

Occurrence.—Occasionally inside the reef and in the reef passages, and regularly in small numbers in the fine-meshed nets fished outside the reef.

Length : ♀, 1·15 mm.

Calocalanus styliremis, Giesbr.

Giesbrecht, 1892.

Occurrence.—Outside the reef, over deep water : very scarce.

Length : ♀, ·62–·68 mm. Possibly its scarcity is due in part to its small size.

Calocalanus contractus, Farran.

Farran, 1926.

Occurrence.—Found twice inside the reef, but regularly in the fine-meshed nets fished outside the reef. Much less scarce than *C. styliremis*.

Length : ♀, ·66–·84 mm.

Calocalanus plumulosus (Cls.).

Giesbrecht, 1892.

Occurrence.—Only once found inside the reef, Stn. 10, one specimen, but regularly outside over deep water in small numbers.

Length : ♀, 1·05 mm.

Calocalanus pavoninus, n. sp. (Text-fig. 3.)

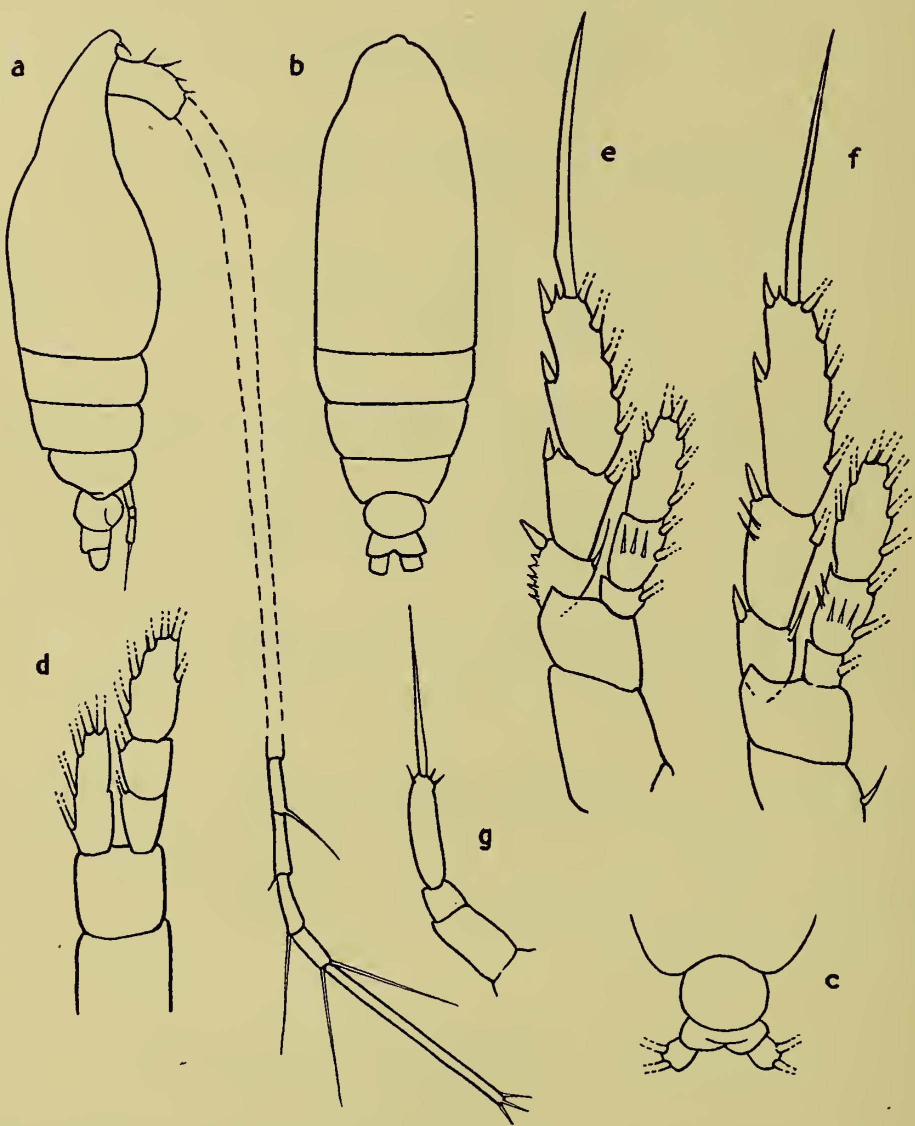
Occurrence.—A few specimens on Stns. 7 and 13 at 3 mi. E. and possibly on others also, since its specific distinctness was not at first recognized.

Description.—Female (Text-fig. 3, *a*, *b*), length ·71 mm., cephalothorax ·61 mm., abdomen ·10 mm. ; width of cephalothorax in dorsal view ·22 mm., or contained $3\frac{1}{4}$ times in the total length ; cephalon not separated from first thoracic segment. Dorsal outline of cephalothorax in lateral view not forming a uniform curve, but bent inwards in a marked re-entrant angle opposite the insertion of the mandible. Abdomen (Text-fig. 3, *c*) 2-jointed ; genital segment slightly wider than long in dorsal view, anal segment about twice as wide as long. Furcal rami about as wide as long, a little shorter than the anal segment.

Antennules about twice as long as the whole animal. Length of joints in ·01 mm. :

	1–2.	3.	4.	5.	6.	7.	8–9.	10.	11.	12.	13.	14.
Length .	10·5	3	2·5	2·5	2·5	2·5	5·5	3·5	3·5	3·5	4	4·5

	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
Length .	5·5	6·5	6·5	8	8	8	8·5	9·5	8	5·5	32



Text-fig. 3.—*Calocalanus pavoninus*, n. sp. Female : *a*, lateral view, × 98 ; *b*, dorsal view, × 98 ; *c*, abdomen, × 150 ; *d*, first foot, × 435 ; *e*, second foot, × 435 ; *f*, third foot, × 435 ; *g*, fifth foot, × 435.

Joints 13 to 20 each with a longitudinal row of very fine spinules along the upper margin, as in *C. pavo.*

Mouth-parts apparently as in *C. styliremis* and *C. contractus.* First foot (Text-fig. 3, *d*) with 3-jointed exopodite and 1-jointed endopodite. Second to fourth feet (Text-fig. 3, *e,f*) with 3-jointed exopodites and endopodites ; there is a transverse row of three or four

spinules across the second joint of the endopodite of the second to fourth feet. The exopodites, as far as could be made out, were without spinules except for a close-set uniform row of teeth-like spinules on the outer edge of the first joint of the exopodite of the second foot, and two moderately long spinules near the outer edge of the second joint of the exopodite of the third foot. The fourth feet were not found entire. Fifth feet (Text-fig. 3, *g*) long and slender, reaching almost to the end of the anal segment, 3-jointed, the second joint about as wide as long, the third joint about four times as long as wide, and terminated by a strong spine with 2–3 fine spinules at its base.

REMARKS.—This species was at first mistaken for *C. contractus*, to which it is closely allied. It is separated, however, by the emarginate dorsal outline of the cephalon in lateral view, by the presence of a single terminal seta on the fifth feet and, in the only instance in which an unbroken antennule was found, by the long terminal joint, longer than the three preceding joints taken together. In practice *C. pavoninus* can be distinguished from *C. contractus*, which it resembles somewhat in form and size, by the single stout seta on the end of the fifth foot, and from *C. styliremis* by the small size and very squat form of the latter.

Ctenocalanus vanus, Giebr.

Giesbrecht, 1892.

OCCURRENCE.—Only taken outside the reef in hauls with 150 m. of warp or more. On every such station it occurred in small numbers in the fine-meshed nets.

Length: ♀, ·81–1·10 mm.; ♂, 1·20 mm.

Spinocalanus abyssalis, Giesbr.

Giesbrecht, 1892.

OCCURRENCE.—Only taken outside the reef in hauls with 250 or 500 m. of warp. Very few specimens.

Length: ♀, ·85–·90 mm.

REMARKS.—All the specimens seemed to belong to the form which I described from the Bay of Biscay (1926) as var. *pygmaeus*, from specimens measuring ·95–1·08 mm.

TANYRHINUS, n. gen.

Body resembling *Calanus* in general form. Cephalon separated from first thoracic segment. Fourth and fifth thoracic segments separate. Rostrum of a single stout point. Abdomen 4-jointed. Antennules 23-jointed, joints 8–9 and 24–25 being fused. Second antenna as in *Mimocalanus*, with 2 setae on the inner margin of the second joint of the exopodite. Mandible with large 2-branched palp; endopodite 2-jointed, longer than the exopodite. Maxilla as in *Mimocalanus* and *Spinocalanus*. Second maxilla as in *Paracalanus*, except that the fourth lobe is larger than the fifth. Maxillipede of *Mimocalanus* type, with well-developed setae on the outer margin of the last two joints. Swimming-feet with jointing and setae as in *Spinocalanus*, except that the first and second joints of the exopodite of the first foot are without setae. Fifth feet absent.

The systematic position of this genus, in the neighbourhood of *Spinocalanus*, *Mimocalanus* and *Monacilla*, is indicated by the presence of five setae on the inner edge and

three spines on the outer edge of the third joint of the exopodite of the second to fourth feet and the absence of the fifth feet. The separation of the cephalon and first thoracic segment and of the fourth and fifth thoracic segments are characters in which it approaches *Mimocalanus* and *Monacilla.* The unusually long third joint of the exopodite of the first foot is unusual, as is also the well-developed single rostrum, on which no trace of rostral filaments could be detected. The presence of a 2-pointed asymmetrical rostrum in *Monacilla tenera,* with one of the points much stronger than the other, suggests that a single rostral process might arise by the suppression of the smaller point.

Tanyrhinus naso, n. sp. (Text-fig. 4.)

Occurrence.—One specimen outside the reef, on Stn. 28, C. 600–0 m.

Description.—Female (Text-fig. 4, *a*, *b*), length ·89 mm., cephalothorax, in the middle line, ·67 mm., abdomen ·22 mm. Cephalon narrow and pointed in dorsal view but somewhat flattened laterally, with stout conical rostrum (Text-fig. 4, *c*) extending between the bases of the antennules. Abdominal segments and furca (Text-fig. 4, *d*) in the proportion 21.12.13.16.16. Antennules (Text-fig. 4, *c*) 23-jointed, reaching to about the anal segment, length ·69 mm. Length of joints in ·01 mm. :

Text-fig. 4.—*Tanyrhinus naso*, n. sp. Female : *a*, dorsal view, × 68 ; *b*, lateral view, × 68 ; *c*, front of cephalon and rostrum ; *d*, abdomen, × 240 ; *e*, antennule, × 166 ; *f*, antenna ; *g*, mandible palp ; *h*, second maxilla ; *i*, maxillipede ; *j*, first foot ; *k*, second foot ; *l*, fourth foot (*f*–*l* × 260).

	1.	2.	3.	4.	5.	6.	7.	8–9.	10.	11.	12.	13.
Length .	5·1	4·5	2·0	1·9	1·8	1·9	1·9	3·2	2·0	2·0	2·3	2·3

	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24–25.
Length .	2·5	2·5	2·8	2·7	3·1	3·4	3·4	3·7	3·8	5·0	6·4

Setae on seventh, fourteenth, eighteenth and twenty-first joints stronger than the rest ; distal setae on the posterior margin of twenty-second and twenty-third joints and a median seta on the posterior margin of the last joint. Antenna (Text-fig. 4, *f*) with endopodite equal in length to the exopodite, which has two setae on the inner margin of the second joint. Mandible (Text-fig. 4, *g*) with endopodite longer than the exopodite. Maxilla as in *Paracalanus*. Second maxilla (Text-fig. 4, *h*) as in *Spinocalanus*. Maxillipede (Text-fig. 4, *i*) with oblique segmentation between first and second joints.

First foot (Text-fig. 4, *j*) with endopodite long and narrow ; exopodite without outer edge spines on first and second joints ; third joint almost as long as first and second taken together, with four inner edge setae. Second to fourth feet (Text-fig. 4, *k*, *l*), exopodite with 1.1.3 outer edge spines and 1.1.5 inner edge setae ; terminal spines about four-fifths as long as the third joint, with narrow laminae and moderately coarse serrations.

Aetideus armatus, Boeck.

Sars, 1903.

Occurrence.—On Stn. 19 outside the reef, one female in the 1 m. silk net, 180–0 m., and another, dead when caught, in coarse silk net 180–0 m.

Length : ♀, 1·33–1·44 mm.

Euaetideus acutus (Farran).

Aetideus acutus, Farran, 1929.

Occurrence.—Several specimens were taken on the deep-water stations 19, 20, 28, 45 and 50, outside the reef.

Length : ♀, 1·56–1·62 mm. ; ♂, 1·23–1·30 mm. These are slightly smaller than the specimens originally described from New Zealand (Farran, 1929), but agree closely otherwise.

Euaetideus giesbrechti (Cleve).

Aetideus giesbrechti, Sars, 1925.

Occurrence.—One male, stage V, length 1·63 mm., was taken on Stn. 45, C. 500–0 m. Though the specimen was immature, there seems no risk of error in referring it to this species, which has already been recorded from New Zealand (Farran, 1929).

Chiridius gracilis, Farran.

Farran, 1908. With, 1915.

Occurrence.—One female on Stn. 28, S. 600–0 m., and an immature male, probably of the same species, in the coarse silk net at the same depth.

Length : ♀, 2·70 mm.

Undinopsis tropicus, Wolfenden.

Wolfenden, 1905.

Occurrence.—This species, benthic by day, was moderately common in the serial night hauls (Stn. 65) at 3 mi. E., when it was taken in the net with 10 m. of warp, with a maximum in the net with 20 m. of warp. One specimen was found near the bottom, 40 m. of warp, in the serial hauls by day at 3 mi. E. (Stn. 62), two females in the stramin net, 32–0 m., on Stn. 21 at 8.40 p.m., and one immature specimen in a haul with 150 m. of warp over a depth of 400 m. on Stn. 50—a daylight haul. In these movements it agrees with the closely allied species *U. bradyi*.

Length : ♀, 1·55–1·63 mm. ; ♂, 1·26–1·28 mm.

Remarks.—These specimens are slightly larger than those from the Maldive Archipelago (♀, 1·2 mm.) for which Wolfenden (1905) proposed the name *U. tropicus*, but are much smaller than the North Atlantic species *U. bradyi*, which measures, ♀, 2·4–2·6 mm.

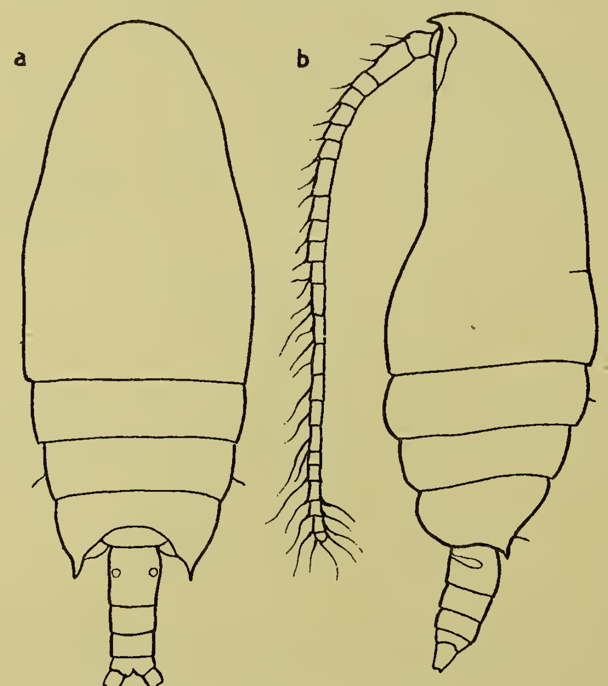
Pseudotharybis zetlandica, T. Scott. (Text-fig. 5.)

T. Scott, 1909.

Occurrence.—One specimen in the bottom stramin net on Stn. 29, 205 m.

Length : ♀, 3·18 mm.

Remarks.—Although this specimen (Text-fig. 5, *a*, *b*) is smaller than that originally described by T. Scott (1909) from off the North coast of Scotland (3·8 mm.), and differs somewhat in the shape of the body from the figure given by Scott, there does not seem to be sufficient reason for separating it. The original specimen was taken from deep water, 1140 m., and we may assume that it came from a townetting taken at or close to the bottom, as several other specimens have since then been taken in townets attached to trawls in deep water off the west coast of Ireland. The numerous strong setae on the



Text-fig. 5.—*Pseudotharybis zetlandica*. Female : *a*, dorsal view, × 28 ; *b*, lateral view, × 28.

antennules, such as are found in *Undinopsis* and *Bryaxis*, both bottom-living genera, are possibly an adaption to life on the bottom. The Irish specimens, which measured 4·4 mm., were similar in form to that here recorded.

Gaetanus miles, Giesbr.

Giesbrecht, 1892.

Occurrence.—One specimen on Stn. 28, C. 600–0 m.

Length : Stage V, 2·52 mm. ; antennules, 6·84 mm. There is no described species but *G. miles* to which this immature specimen can be referred.

Gaetanus pileatus, Farran.

Giesbrecht, 1924.

Occurrence.—One dead specimen, female, on Stn. 28, S. 600–0 m.

Gaetanus minor, Farran.

Giesbrecht, 1924.

Occurrence.—Three females and one stage IV on Stn. 28, C. 600–0 m.

Length : ♀, 2·10 mm.

Undeuchaeta plumosa (Lubb.).

Undeuchaeta minor, Giesbrecht, 1892.

Occurrence.—On Stn. 28, one female and two specimens stage V in the coarse silk net, 600–0 m., and five females and one specimen stage V in the stramin net, 600–0 m.

Length : ♀, 3·25–3·50 mm.

Euchaeta longicornis, Giesbr.

Giesbrecht, 1892.

Occurrence.—Characteristic of oceanic waters, as it only occurred outside the reef, but apparently not a deep-water form, as on Stn. 50 eight females were taken in a vertical haul from 150 m. and one in another haul from 170 m. It also occurred in four hauls from deeper water, on Stns. 20, 28, 45 and 50, from one to four specimens in each, but was probably taken during the ascent of the net.

Length : ♀, 2·67–2·76 mm.

Euchaeta media, Giesbr.

Giesbrecht, 1892.

Occurrence.—One female on Stn. 28, S. 600–0 m. Probably taken near the surface when hauling.

Length : ♀, 3·80 mm.

Euchaeta concinna, Dana. (Text-fig. 6.)

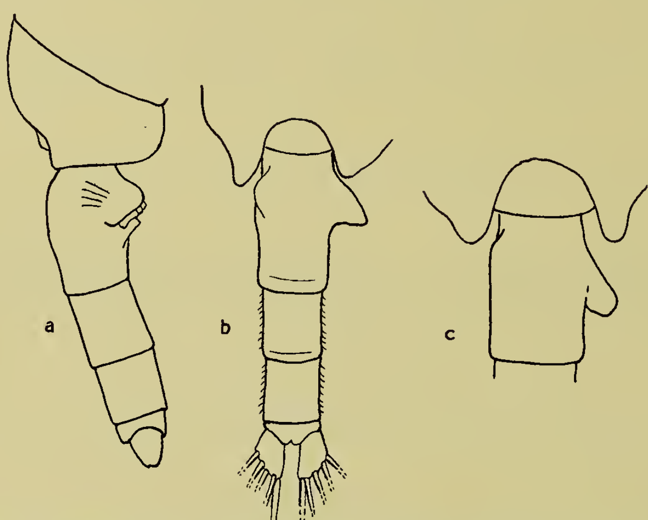
Giesbrecht, 1892.

Occurrence.—One of the most characteristic species of the fauna inside the reef occurring frequently and sometimes very plentifully at 3 mi. E., where it showed a marked maximum from May to October. Absent outside the reef.

Length : ♀, 3·25–3·40 mm. (Text-fig. 6, *c*) ; ♂, 2·54–2·76 mm. As Dana's original description is not accompanied by figures I have taken Giesbrecht's (1892) figures as indicating the species.

Euchaeta consimilis, n. sp. (Text-fig. 6.)

Occurrence.—Stn. 28, C. 600–0 m., ♀ 1. Stn. 29, stramin bottom net, 205 m., ♀ 1. Stn. 50, S. 400–0 m., ♀ 2.



Text-fig. 6.—*Euchaeta consimilis*, n. sp. Female abdomen : *a*, lateral view, × 55 ; *b*, dorsal view, × 55. *Euchaeta concinna*. Female : *c*, genital segment, × 55.

Description.—Outside the reef the place of *E. concinna* was taken by a few specimens, females, of a smaller species, length 2·36–2·67 mm., which closely resembles it, but seems to deserve recognition as being specifically distinct. The grounds for separating the smaller species lie in the size, coupled with a difference in distribution and a difference in the form of the projection on the right side of the genital segment when seen in dorsal view (Text-fig. 6, *b*). The appendages do not differ from those of *E. concinna*. This species is very closely allied to *E. concinna* as identified and figured by Giesbrecht (1892), and it seems probable that it has been regarded as an extreme form of it by others. Wolfenden's (1905) figure of a specimen of *E. concinna* from the Maldive Archipelago undoubtedly refers to *E. consimilis*, and A. Scott (1909) has included both Giesbrecht's and Wolfenden's references in his list of synonyms, from which it might be inferred that they were accepted by him as identical. Dana's (1849) original description of *E. concinna* could be taken as referring to *E. consimilis*, but Giesbrecht, who was the next to use the name, gave figures which showed that he had the larger species before him, and unnecessary confusion would be caused by the rejection of his identification. Seymour Sewell (1929) mentions that *E. concinna* is the most common species of the genus in Indian waters, and

records the measurements of a large number of specimens from a single station. These cover, for the females, a range of ca. 2·5–3·5 mm. He comments on the degree of variation in the size of the projection on the right side of the genital segment, and may have regarded the present species as a form of *E. concinna.*

A few specimens of *E. consimilis*, apparently identical with that here described, were found in a small collection of copepods made at Christmas Island in 1908 by the late Dr. C. W. Andrews. *E. concinna* appeared to be absent from this collection.

Euchaeta wolfendeni, A. Scott.

A. Scott, 1909.

Occurrence.—One specimen was taken at 3 mi. E. on Stn. 6. Outside the reef it was found on Stn. 19, S. 180–0 m., 2 specimens; C. 180–0 m., 2 specimens; and on Stn. 20, N. 250–0 m., 8 specimens.

Length : ♀, 2·55–2·64 mm.

Remarks.—This seems to be an epiplanktonic species like *E. longicornis*, but much scarcer. The specimen on Stn. 6 had probably drifted in. Sars (1925) claims that *E. wolfendeni* is a synonym of his *E. pubera*, but, as Seymour Sewell (1929) has pointed out, Sars' figures of *E. pubera* are not at all like *E. wolfendeni*.

Euchaeta russelli, n. sp. (Text-fig. 7.)

Occurrence.—This is the characteristic *Euchaeta* of the waters outside the reef, as *E. concinna* is of the shoal-water inside. Males, females and immature specimens were taken in considerable numbers on every haul made outside the reef. The most productive haul was on Stn. 29, stramin bottom net at 205 m., which gave 140 females.

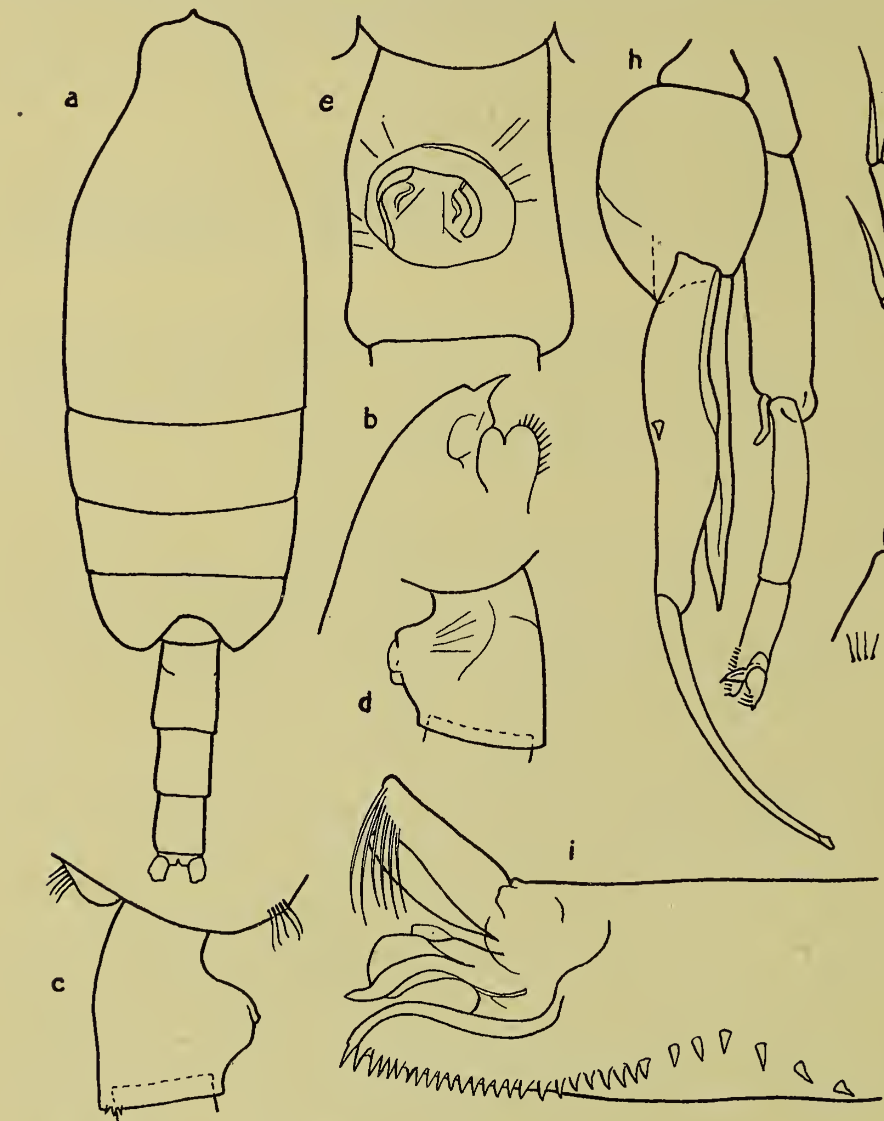
Description.—Female (Text-fig. 7), length, 4·24–4·38 mm. Cephalothorax $2\frac{1}{2}$ times as long as the abdomen, in the proportion, in mid-dorsal line, of 3·08 to 1·24. Frontal prominence slight. Last thoracic segment with bluntly rounded lateral margins, which bear each a postero-ventral tuft of hairs. There is a medio-dorsal tuft of hairs just posterior to the hinder margin of the last segment of the carapace. Abdominal segments and furca in the proportion 60.40.35.2.20, the anal segment being almost concealed beneath the preceding segment. Genital boss (Text-fig. 7, *c*, *d*) slightly projecting. Genital opening (Text-fig. 7, *e*) enclosed by a pair of low, curved lateral plates, that on the left side being shorter and more opaque than that on the right. Within these plates are a pair of ridges not visible in lateral view. There is a faint transverse dorso-lateral ridge to the left of the middle line at the anterior third of the genital segment. On the postero-ventral margin of the genital segment is a small median tuft of fine hairs. The posterior margins of the genital and second abdominal segments bear a few fine spinules, otherwise the abdomen is smooth. The furca is setose. Terminal furcal setae of about equal thickness and length, about two-thirds of the abdomen, except the second from within, which is about twice as long as the rest. Appendicular seta basally as thick as the other furcal setae and about twice as long as the abdomen.

Antennules reaching to the posterior margin of the genital segment. Other cephalic appendages closely resembling those of *Euchaeta hebes*.

First foot (Text-fig. 7, *f*) with the segmentation between the first and second joints of the exopodite faintly indicated, outer edge seta very minute. Second foot with terminal spine about equal to the third joint of the exopodite. First outer edge spine of

the third joint of the exopodite very short; second outer edge spine long, slightly longer than the outer edge spine of the second joint and almost reaching to the end of the third outer edge spine.

Male, length 3·74–4·08 mm. Cephalon to abdomen in the proportion 9 to 4. Fifth feet (Text-fig. 7, *h, i*) of the same type as in *Euchaeta hebes,* but with the comb-like



Text-fig. 7.—*Euchaeta russelli,* n. sp. Female, *a,* dorsal view, × 27; *b,* rostrum, × 52; *c, d,* genital segment, lateral view, × 52; *e,* genital segment, ventral view, × 96; *f,* first foot, × 125; *g,* third joint of exopodite of second foot, × 77. Male: *h,* fifth feet, × 51; *i,* terminal joint of exopodite of left fifth foot, × 320.

ridge on the second joint of the exopodite of the left foot more regular, and running along the margin of the joint.

Remarks.—A. Scott (1909), in dividing the original Genus *Euchaeta* into two sections, *Euchaeta* and *Pareuchaeta,* took as one of the distinguishing marks of *Euchaeta* the presence of long widely separated spinules on the innermost seta of the sixth lobe of the first maxillipede, more properly known as the second maxilla. In *Pareuchaeta* this seta

bears a uniform closely set fine spinulation. In his figures of these setae he designates them, by an obvious oversight, as those of the second maxillipede. The other distinguishing character which he indicates is the spinous prolongation in *Euchaeta* of the tip of the third joint of the exopodite of the male left fifth foot.

Sars (1925), in his diagnosis of the two genera, introduces a third character, the appendicular seta on the furca of the female. In *Euchaeta* this seta is long and thickened ; in *Pareuchaeta* it is more slender than the terminal furcal setae. Relying apparently on the first and last of these three characters he includes the species *hebes* in the genus *Euchaeta*, although the third joint of the left fifth foot exopodite of the male is not prolonged into a point. The present species occupies a similar position to *E. hebes* as in it the thickened appendicular seta is present, and also the long spinules on the innermost seta of the sixth lobe of the second maxilla, but the spinous prolongation of the left fifth foot of the male is absent.

Xanthocalanus squamatus n. sp. (Text-fig. 8.)

Occurrence.—One specimen, somewhat injured, on Stn. 19, outside the reef, in a vertical haul from 180 m., over a depth of 225 m., consequently not far from the bottom.

Description.—Female (Text-fig. 8, *a*), length, 3·2 mm. Body stout, ovate, with short, stout abdomen. Fifth thoracic segment (Text-fig. 8, *b*) produced laterally into sharp points. Length of cephalothorax to end of lateral points 2·7 mm., cephalon 1·75 mm., abdomen ·63 mm. The abdomen is sparingly clothed with small transparent scales or scale-like spinules which seem to be easily rubbed off.

Length of joints of the antennule in ·01 mm., measured along the posterior edge :

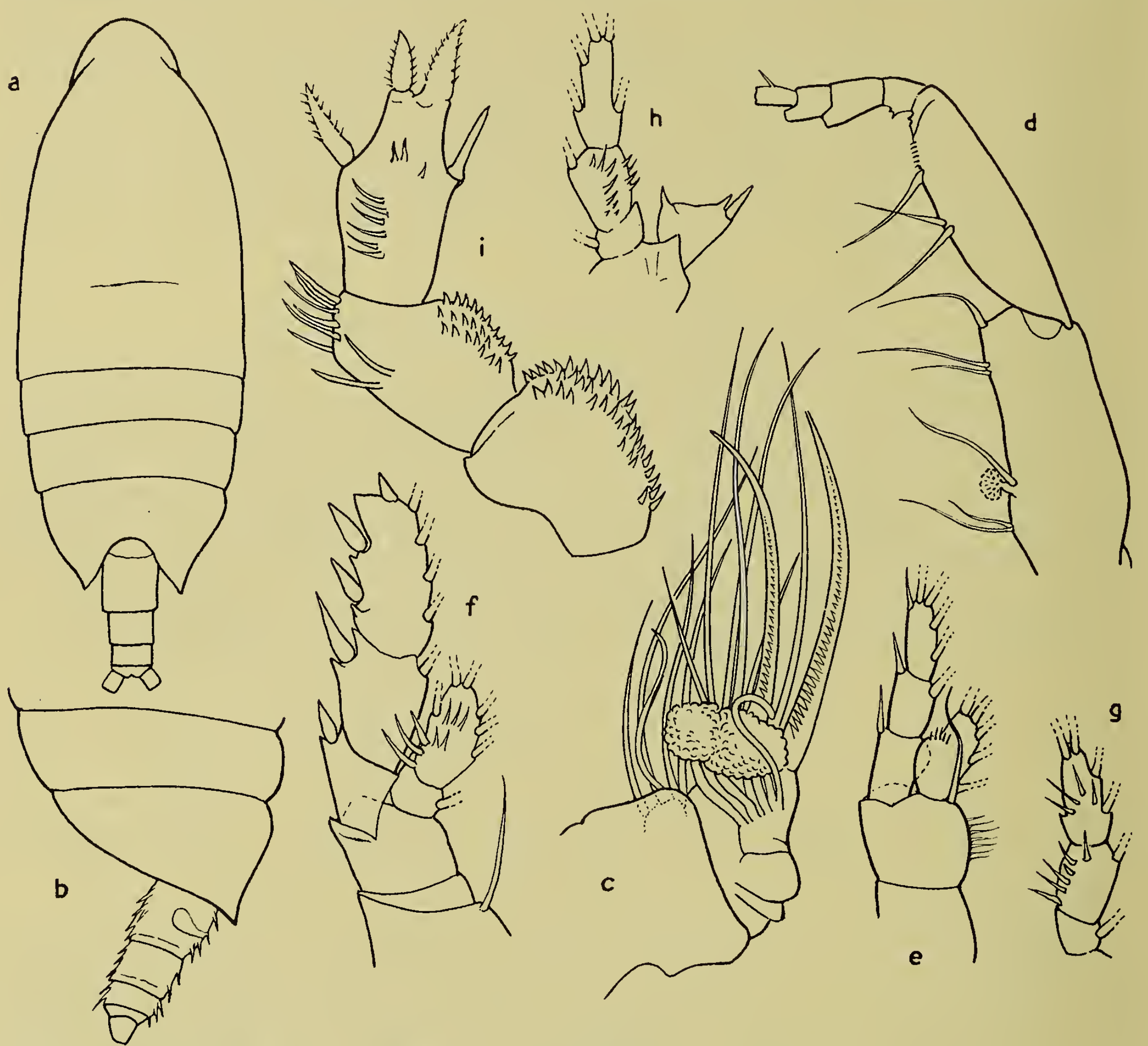
	1.	2.	3.	4.	5.	6.	7.	8–9.	10.	11.	12.	13.
Length .	23	13·5	9·4	8·8	9·4	9·4	8·8	14·2	6·7	8·1	10·5	12·1

	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
Length .	12·6	15·5	16·1	16·1	15·1	12·8	12·1	10·8	7·7	13·5	14·8	x

Joints 8 and 9 fused, terminal joint missing.

Aesthetascs are present on joints 2, 3, 8–9, 12, 14 and 19, noticeable setae on the anterior margins of joints 1 (2), 2 (4), 4 (2), 7 (1), 14 (1), 18 (1) and 21 (1), and minute setae on the other joints. Antenna with endopodite about half as long as the exopodite. Mandible palp with equal rami. Maxilla not examined in detail. Second maxilla (Text-fig. 8, *c*) with stout toothed spines on the fourth and fifth lobes, terminal setae scoleciform, their ends coalescing in a spongy rounded bilobed mass, except the most distal, which is not involved. Maxillipede (Text-fig. 8, *d*) with a short-stalked sheaf-like seta on the proximal third of the first joint. First foot (Text-fig. 8, *e*) with outer edge spines on all joints of the exopodite. Second foot (Text-fig. 8, *f*), exopodite without spinules, endopodite with an oblique and a transverse row of spinules on the second joint. Third foot, exopodite without spinules, endopodite (Text-fig. 8, *g*) with an oblique row of spinules on the second joint and a curved transverse row on the third joint. Fourth foot with minute spinulation on the face of the third joint of the exopodite ; endopodite (Text-fig. 8, *h*) with both large and small spinules on the face of the second joint, and a row of spinules on its outer margin.

Fifth foot (Text-fig. 8, *i*) 3-jointed; inner margin of first and second joints closely beset with short, stout spinules, outer edge of second joint with a distal group of long cultriform spinules; a smaller group of similar spinules is present on the face of the third joint. The third joint with outer edge spine, two terminal spines and an inner edge spine. The outer edge and the two terminal spines have serrated margins, the



Text-fig. 8.—*Xanthocalanus squamatus*, n. sp. Female: *a*, dorsal view, × 28; *b*, abdomen, lateral view, × 39; *c*, second maxilla, × 88; *d*, maxillipede (setae on terminal joints not shown), × 88; *e*, first foot, × 88; *f*, second foot, × 88; *g*, endopodite of third foot, × 88; *h*, endopodite of fourth foot, × 88; *i*, fifth foot, × 300.

inner edge spine is smooth and subulate. The innermost of the two terminal spines is not articulated, but is formed by a prolongation of the joint.

Remarks.—The small size of this species, its acute fifth thoracic segment and its short scale-clad abdomen separate it from any previously described species. *X. agilis*, described by Giesbrecht (1892) from the Mediterranean, has a short abdomen, densely covered with shaggy hairs, but it is not said that they are scale-like, and the prolongations of its fifth thoracic segment are longer and are rounded at the ends.

Racovitzanus antarcticus, Giesbr.

Giesbrecht, 1902.

Occurrence.—Three females and one male, all dead when taken and in a very battered condition, were found on Stn. 28, C. 580–0 m. The occurrence of this Antarctic species is noteworthy, as it implies a northerly drift at a considerable depth from the area south of 66° 30′ S., where it is frequent at depths below 400 m.

Length : ♀, 1·77–1·88 mm. ; ♂, 1·80 mm.

Scolecithrix danae (Lubb.).

Giesbrecht, 1892.

Occurrence.—Taken from time to time inside the reef in small numbers, most frequently in September. It occurred also in Trinity Opening, Stn. 26, and outside the reef on Stns. 19 and 50.

Length : ♀, 2·16 mm.

Scolecithrix bradyi, Giesbr.

Giesbrecht, 1892.

Occurrence.—In contrast to *S. danae*, this species was only taken outside the reef, where it occurred in small numbers on Stns. 19, 20, 28, 45 and 50, in vertical hauls.

Length : ♀, 1·08–1·20 mm. ; ♂, 1·0 mm.

Scolecithrix ctenopus, Giesbr. (Text-fig. 9.)

Scolecithricella ctenopus, Sewell, 1929.

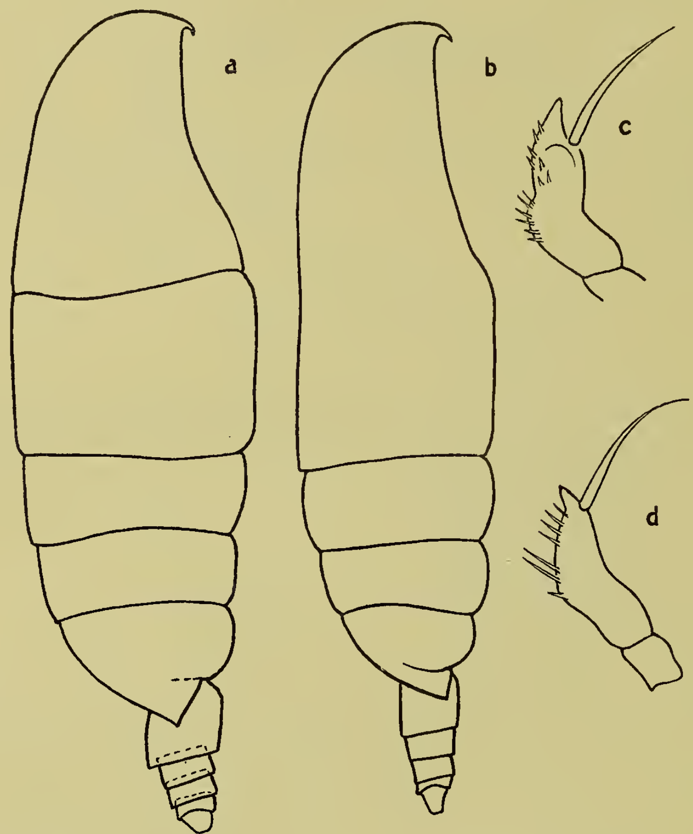
Occurrence.—Stn. 28, C. 600 m., one female. Stn. 45, C. 500 m., one female.

Remarks.—This species was described by Giesbrecht in 1888, and figured in 1892, from a male, length 1·3 mm., taken in the tropical Pacific. The male was again recorded and figured by T. Scott (1894) from five specimens, length 1·83 mm., taken in the Gulf of Guinea from 20–50 fathoms. No female was found by Scott, but the female of a closely allied species, length 1·54 mm., was taken in two hauls, from 135 fathoms and 300 fathoms, and was described as new species, *S. longicornis*.

A. Scott (1909) recorded both *S. ctenopus* and *S. longicornis* from the Malay Archipelago, one male of the former being taken in a haul of 900–0 m., and four females of the latter in hauls from 1000–0 m., and 10–0 m. Seymour Sewell (1929) has taken a male in the Indian Ocean, which he refers to *S. ctenopus*, comparing it with Giesbrecht's and Scott's figures of that species, and, in company with it, a female, length 1·26 mm., which he describes and figures as *S. ctenopus*, commenting on the closeness of similarity which it has to the female *S. longicornis*.

The question now arises whether these two species may not be two forms of a variable species. The differences, in the female, which tell against this view are the indication of segmentation between the cephalon and thorax which is found in *S. ctenopus*, but is apparently absent in *S. longicornis*, and the shorter and stouter abdomen found in *S. ctenopus*.

Of the two females in the Barrier Reef collection, the larger, length 1·47 mm., from Stn. 28, appears to be, without doubt, the same as that figured by Sewell as *S. ctenopus.* It differs only in having the segmentation between the cephalon and thorax more complete, and in having the fifth feet of a single free joint with a median constriction but no definite segmentation. The other specimen, from Stn. 45, is smaller, 1·25 mm., more slender in body, with no indication of segmentation between the cephalon and thorax and with an abdomen proportionally more slender. The fifth feet are of the same type as those of the larger specimen, but do not show the marked constriction of the single free joint.



TEXT-FIG. 9.—*Scolecithrix ctenopus.* Female : *a,* lateral view (Stn. 28), × 75 ; *b,* lateral view (Stn. 45), × 75 ; *c,* fifth foot (Stn. 28), × 390 ; *d,* fifth foot (Stn. 45), × 390.

The other appendages are almost identical with those figured by Sewell and with those of the larger specimens.

For the present it seems advisable to regard *Scolecithrix ctenopus* and *S. longicornis* as belonging to one variable species, and to record these two specimens under the former, earlier name. Text-fig. 9 shows each of the specimens in lateral view and their fifth feet.

Scolecithricella dentata (Giesbr.).

Scolecithrix dentata, Giesbrecht, 1892.

OCCURRENCE.—Taken only outside the reef, one mature female on Stn. 19, 180–0 m., and two, stage V on Stns. 20, 250–0 m., and 21, 600–0 m.

Length : ♀, 1·35 mm.

Scolecithricella ovata (Farran).

Scolecithrix ovata, Sars, 1924.

Occurrence.—Outside the reef only. One mature female on Stn. 20, 600–0 m., and two, stage V, on Stn. 45, 500–0 m.

Length: ♀, 1·75 mm. Fifth foot of typical form on one side: on the other the smaller of the two inner edge spines is absent. Terminal spines of exopodites of second feet with thirty-six serrations.

Scolecithricella profunda (Giesbr.).

Scolecithrix profunda, Giesbrecht, 1892.

Occurrence.—One female on Stn. 28, 600–0 m.

Length: ♀, 2·04 mm. Though widespread, this seems to be a very scarce species. Scott records it from the Malay Archipelago (1909), and it has twice been recorded from the Mediterranean, by Giesbrecht (1892), who first described it from a Mediterranean specimen, and by Sars, who has figured it (1924) under the name of *S. abyssalis*. The form of the fifth feet with rounded distal margins distinguishes it from *S. abyssalis*.

Scolecithricella vittata (Giesbr.).

Scolecithrix vittata, Giesbrecht, 1892.

Occurrence.—Two specimens from outside the reef, Stn. 20, N. 250–0 m., and Stn. 28, C. 600–0 m.

Length: ♀, 1·66–1·74 mm.

Scolecithricella tenuiserrata (Giesbr.).

Scolecithrix tenuiserrata, Giesbrecht, 1892.

Occurrence.—Taken in very small numbers, eight females and four immature specimens, on three stations outside the reef: Stn. 19, C. 180–0 m.; Stn. 20, N. 250–0 m.; and Stn. 50, C. 150–0 m.

Length: ♀, 1·00–1·12 mm.

Remarks.—The abdomen in the females was relatively slightly shorter than the measurement given by Giesbrecht (1892) for his Mediterranean specimens, being contained about 3·75 times in the length of the cephalothorax instead of 3·6 times. It was also noticeably stouter than is shown in Giesbrecht's figure. The anal segment was almost concealed by the preceding segment. The thumb-like projection on the first basal joint of the fourth foot is very noticeable without dissection.

Scolecithricella nicobarica (Sewell). (Text-fig. 10.)

Scolecithrix nicobarica, Sewell, 1929.

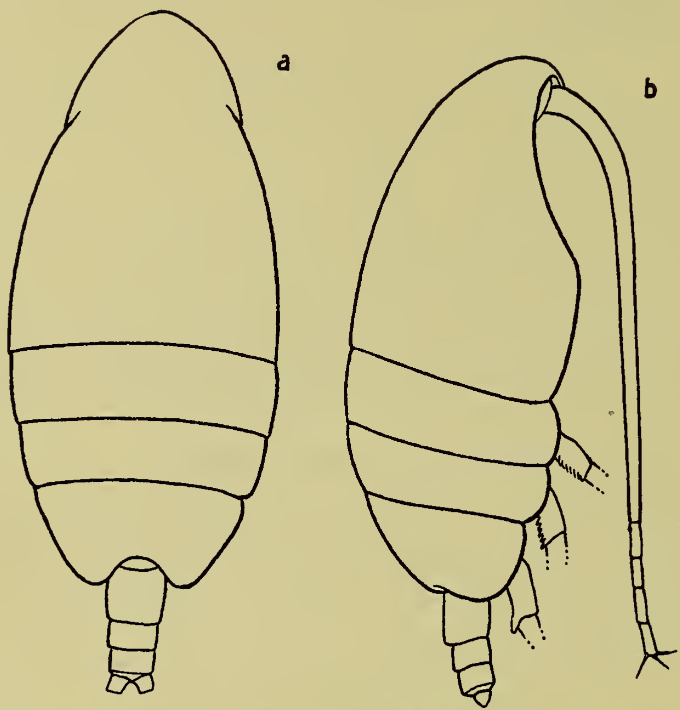
Occurrence.—Four females and two specimens in stage V on Stn. 45, C. 500–0 m.

Length: ♀ (Text-fig. 10, *a*, *b*), 1·35–1·37 mm.

Remarks.—Though these specimens are slightly larger than those described by Sewell (1929) from the Indian Ocean, their very stout form, with fourth and fifth thoracic

segments completely joined and slightly hollowed on their postero-lateral margin, their short abdomen, only one-fourth of the length of the cephalothorax, and the spinulation of the swimming-feet, especially the outer margins of the first basal joints of the second and third feet, make the identification fairly certain.

Though the fifth feet are absent in this species, it resembles *S. tenuiserrata* so closely in other respects that I regard it as congeneric.



TEXT-FIG. 10.—*Scolecithricella nicobarica.* Female : *a,* dorsal view, × 66 ; *b,* lateral view, × 66.

Scaphocalanus echinatus (Farran).

Farran, 1905.

OCCURRENCE.—Two specimens, one dead when taken, from deep water outside the reef on Stn. 28, C. 600–0 m.

Length : ♀, 1·80 mm. The dead specimen had the inner edge spine of the fifth feet more coarsely toothed (*ca.* 8 teeth) than usual.

Lophothrix latipes (T. Scott).

Sars, 1905.

OCCURRENCE.—Two specimens, females, from deep water on Stn. 28, C. 600–0 m., and Stn. 50, S. 400–0 m.

Length : ♀ 2·88 mm.

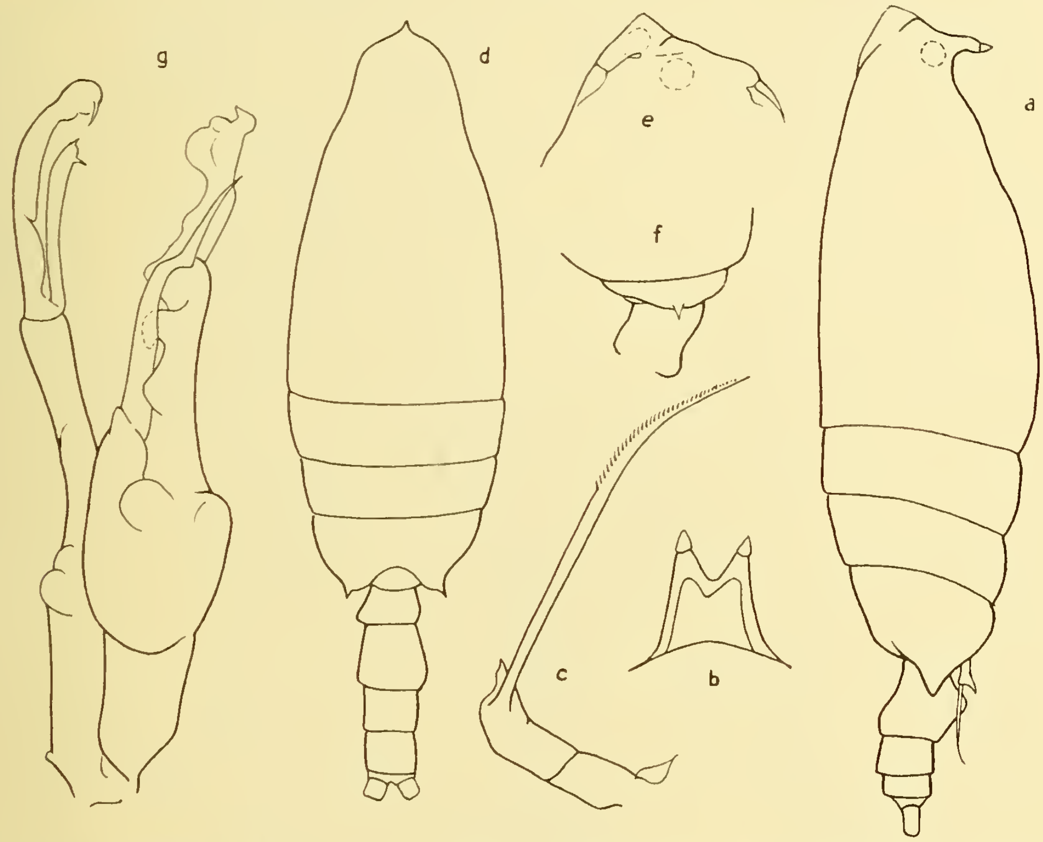
Scottocalanus longispinus, A. Scott. (Text-fig. 11.)

A. Scott, 1909.

OCCURRENCE.—Two females and one male on Stn. 28, 600–0 m.

Length : ♀, 4·32 mm. ; ♂, 4·1 mm.

Remarks.—The female (Text-fig. 11, *a*) appears to be the same as that described by A. Scott (1909) from the "Siboga" collections. It is distinguished by the form of its rostrum (Text-fig. 11, *b*), its fifth thoracic segments produced laterally into triangular points, its short abdomen with the genital segment longer than the three following segments combined. and its fifth feet (Text-fig. 11, *c*) with long slender setae. In company with the two females was a male (Text-fig. 11, *d*), which presumably belongs to the same species. The fifth thoracic segment (Text-fig. 11, *f*) bears short backwardly-directed spines as in *S. thomasi.* The rostrum (Text-fig. 11, *e*) ends in two long transparent filaments, as in



Text-fig. 11.—*Scottocalanus longispinus.* Female : *a*, lateral view, × 25 ; *b*, rostral plate, × 100 ; *c*, fifth foot, × 100. Male : *d*, dorsal view, × 25 ; *e*, head, lateral view, × 45 ; *f*, fifth thoracic segment, lateral view, × 45 ; *g*, fifth feet, × 57.

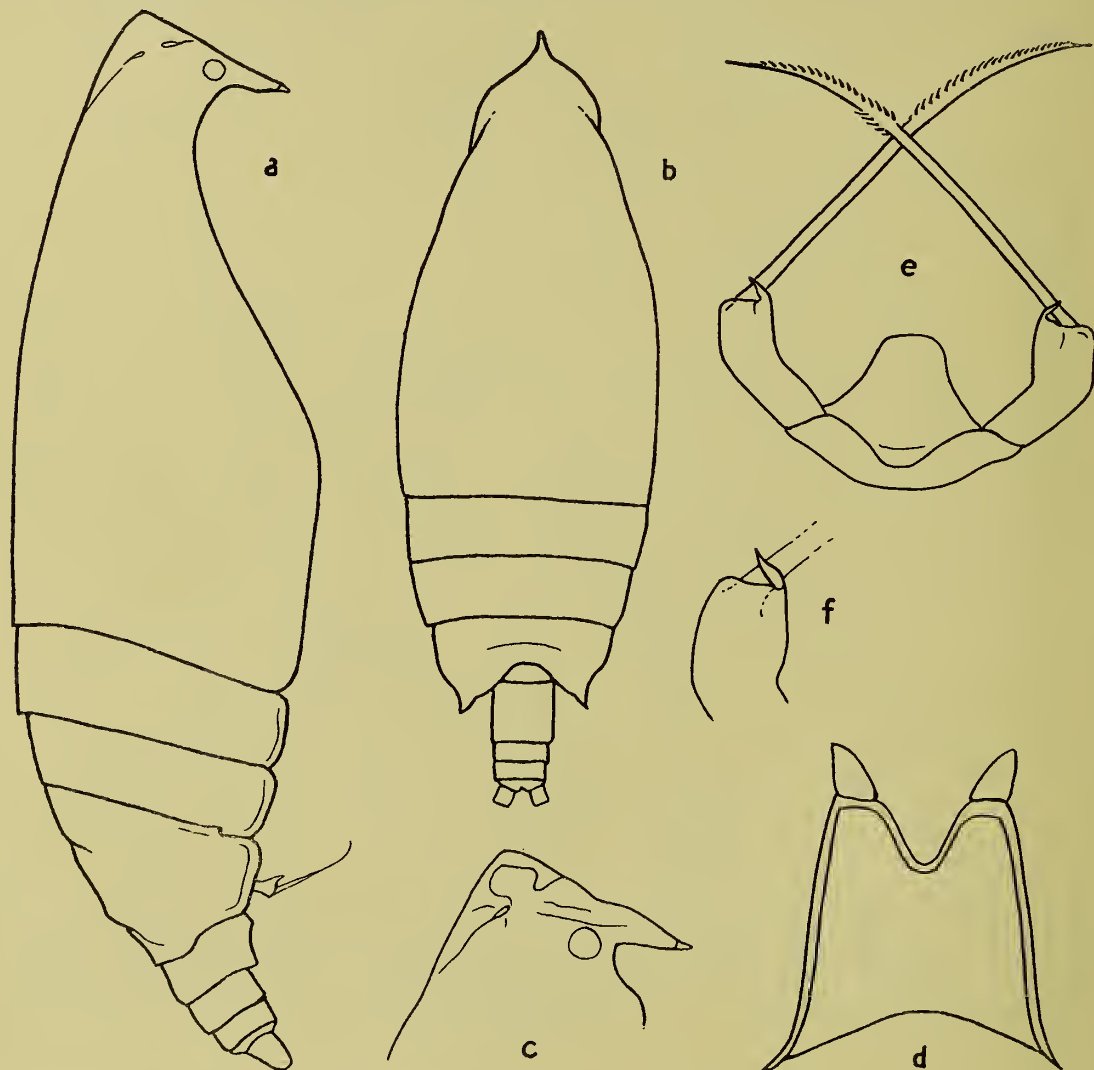
S. persecans, as figured by A. Scott (1909). The fifth feet (Text-fig. 11, *g*), while of the general form found in the genus, differ in most of the details from those of any other described species.

Scottocalanus sedatus, n. sp. (Text-fig. 12.)

Occurrence.—Two females on Stn. 28, 600–0 m.

Description.—Female, length 3·18–3·20 mm. These specimens (Text-fig. 12, *a*, *b*) agree in size and general form with *Scottocalanus setosus* as described by A. Scott (1909), but the following points of difference seem to justify the description of a new species. The last thoracic segment is not terminated by so well developed a point as in *S. setosus*

either in dorsal or lateral view. The fifth feet (Text-fig. 12, *e, f*) differ in bearing a longer seta, which is 2·2 times the length of the jointed portion and three times the length of the terminal joint. The terminal joint of the fifth feet ends in a small spine, which is directed obliquely outwards. The rostral points (Text-fig. 12, *d*) are proportionately much smaller than in *S. setosus*. They agree in size with those of the specimens I have identified as *S. longispinus*, but the rostral plate is much less strongly chitinized than in



Text-fig. 12.—*Scottocalanus sedatus*, n. sp. Female : *a*, lateral view, × 46 ; *b*, dorsal view, × 33 ; *c*, head, lateral view, × 77 ; *d*, rostral plate, × 130 ; *e*, fifth feet, × 130 ; *f*, end of second joint of fifth foot, × 182.

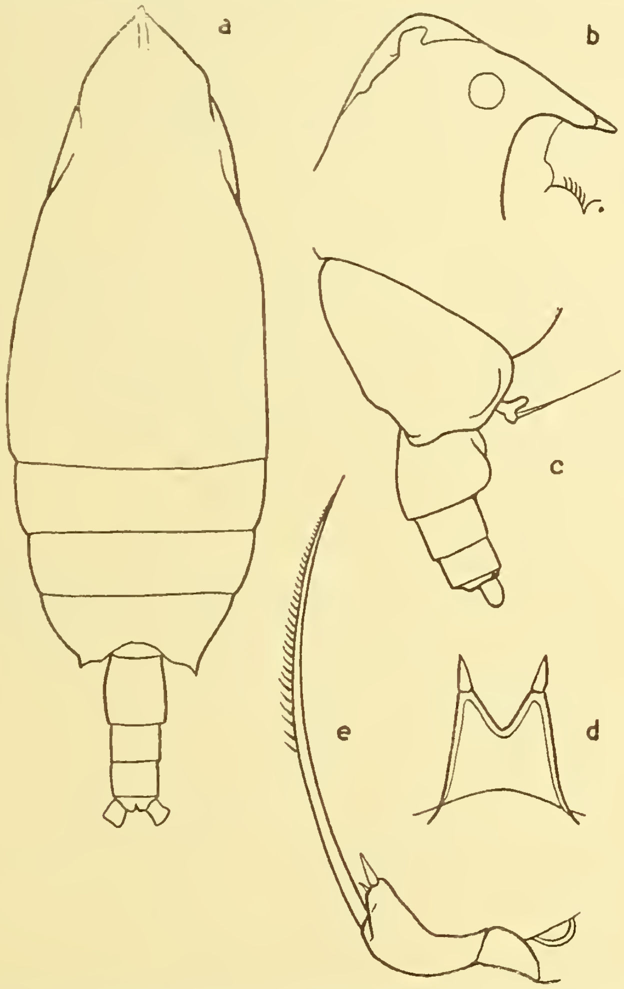
that species. The setae on the furca are symmetrical, at any rate in their basal portions ; the extremities are broken.

Remarks.—Of the other species with sharp thoracic points, *S. thomasi* can be distinguished by its rostrum, which is very broad, with a shallow notch, and *S. securifrons* and *S. cuneifrons* by their more contracted fifth thoracic segment and by the genital segment slightly overlapping the following segment ventrally. No distinctive characters were noticed in any of the appendages except the fifth feet.

Scottocalanus australis, n. sp. (Text-fig. 13.)

Occurrence.—Three females on Stn. 28, outside the reef, 600–0 m., in company with the two preceding species.

Description.—Female (Text-fig. 13, *a*), length 3·96 mm. Abdomen moderately long, being, when contracted, contained 3·8 times in the total length of the cephalothorax. Crest (Text-fig. 13, *b*) low. Fifth thoracic segments (Text-fig. 13, *c*) ending laterally in rounded lappets somewhat similar to those in *S. dauglishi*, but smaller. Genital segment



Text-fig. 13.—*Scottocalanus australis*, n. sp. Female: *a*, dorsal view, × 30; *b*, rostrum, lateral view, × 51; *c*, abdomen, × 42; *d*, rostral plate, × 120; *e*, fifth foot, × 120.

about equal to the two following segments, not much swollen ventrally and not overlapping the following segment. Rostral plate (Text-fig. 13, *d*) slightly chitinized and deeply notched, with comparatively slender rostral spines, which are shorter than the depth of the notch. Fifth feet (Text-fig. 13, *e*) bearing a seta which is about three times as long as the basal portion and four times as long as the terminal joint. The terminal joint ends obliquely, and bears at its extremity a moderately slender spine at the base of which is a minute spinule.

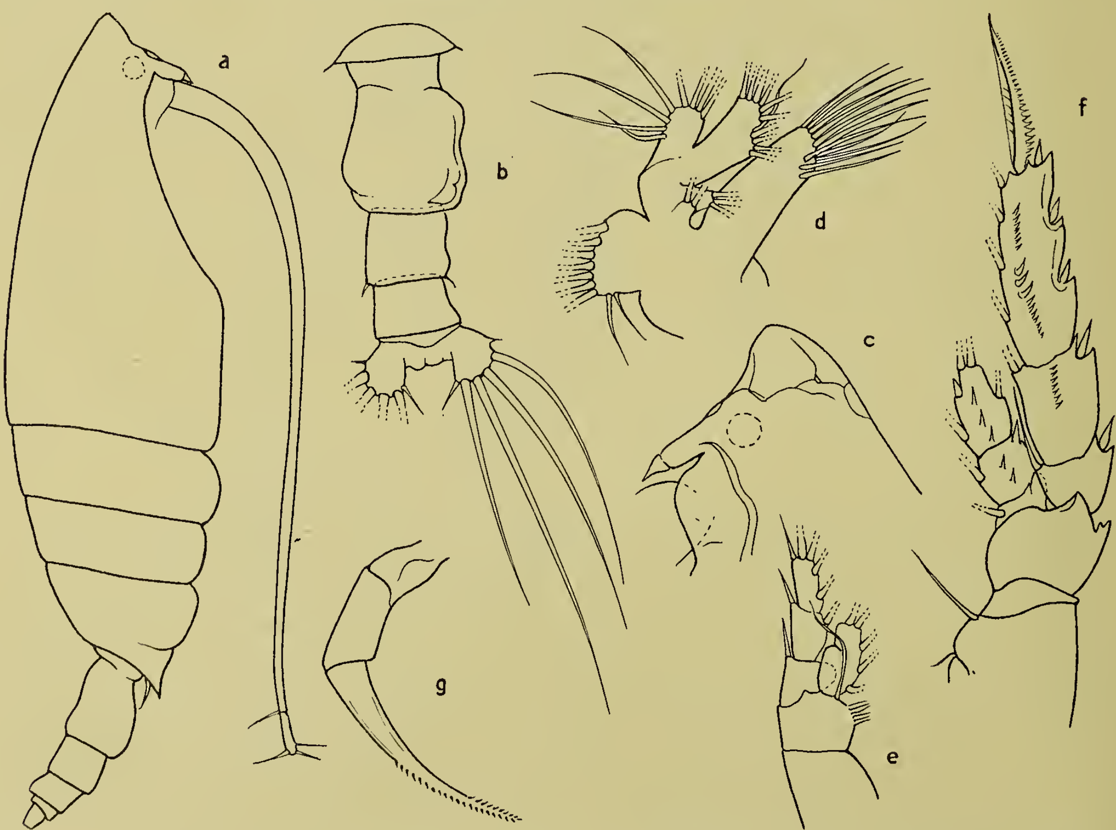
Comparing these specimens with the females of the other species of *Scottocalanus* with rounded fifth thoracic segments, viz. *S. persecans*, *S. helenae* (= *S. thori*), *S. farrani*,

S. terranovae, S. dauglishi: *S. persecans* has only been described very briefly by Esterley, but it appears to differ in its fifth feet; *S. helenae* has a more chitinized rostral plate, with stouter rostral spines, and the fifth thoracic segments are slightly notched at their lateral extremities; *S. farrani* has a rostral plate very similar to that of *S. helenae* and fifth feet with shorter setae; *S. terranovae* has a longer and narrower rostral plate, with much smaller rostral spines; *S. dauglishi* has a larger lappet on the fifth thoracic segment, and its genital segment partially overlaps the following segment. The female of *S. investigatoris* has not yet been described, and may possibly be represented by the present specimens.

REMARKS.—Willey (1919) refers to what he regarded as not fully developed female specimens of *Scolecithrix cuneifrons* from the Gulf of St. Lawrence, but, from the figure which he gives, it would appear that they are in fact adults of a smaller species, which, in the form of the fifth thoracic segment, resembles the present species rather closely.

SCOLECOCALANUS, n. gen.

DESCRIPTION.—Form of body and appendages as in *Scottocalanus* except that the rostral spines are larger and more tapered, the second and third joints of the exopodite of the fourth foot bear a longitudinal row of spinules on their anterior face, and the left fifth foot only is present and consists of a short basal joint bearing a long curved spine. There is an indication of a lenticular thickening at the base of the rostrum, as in *Macandrewella*, with which this genus has some affinities.

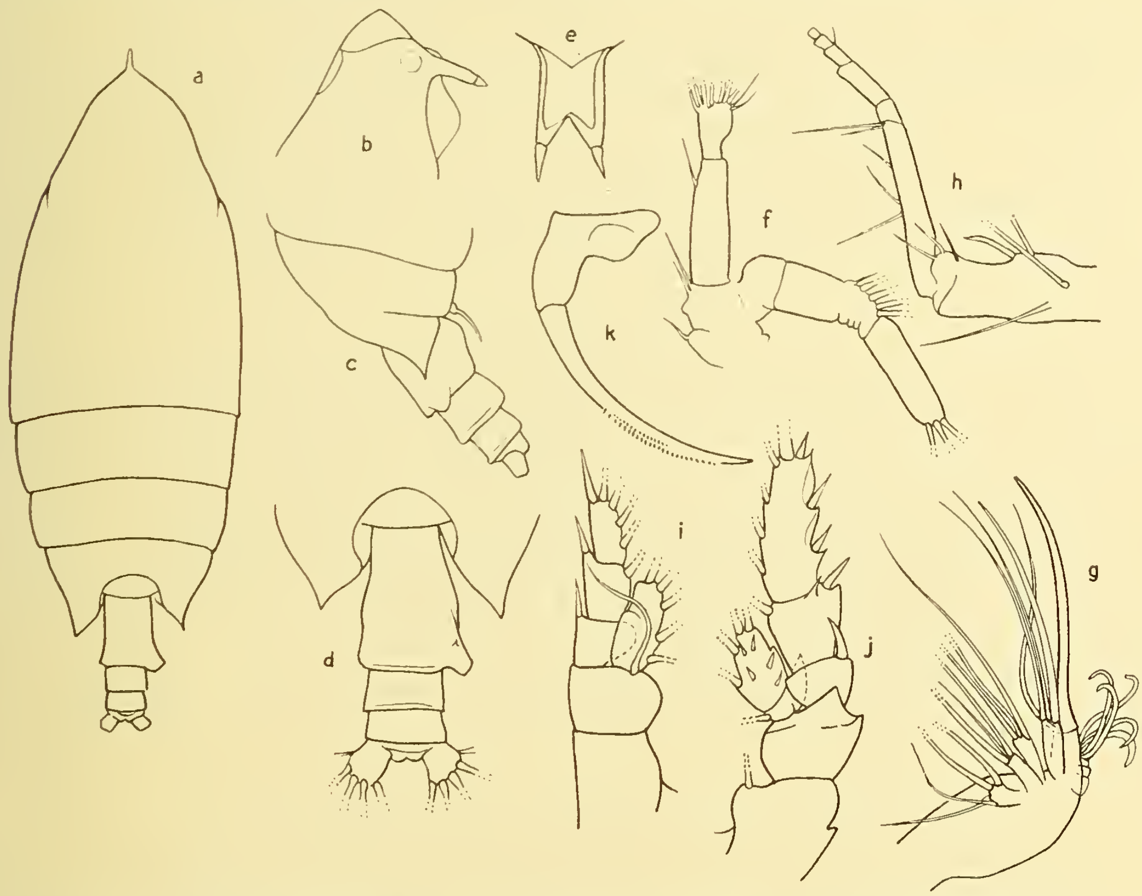


TEXT-FIG. 14.—*Scolecocalanus galeatus*, n. sp. Female: *a*, lateral view, × 24; *b*, abdomen, dorsal view, × 43; *c*, head, lateral view, × 45; *d*, maxilla, × 100; *e*, first foot, × 59; *f*, third foot, × 59; *g*, fifth foot, × 100.

Scolecocalanus galeatus, n. sp. (Text-fig. 14.)

Occurrence.—One female on Stn. 29, stramin bottom net, 209 m.

Description.—Female (Text-fig. 14, *a*) length 4·56 mm., with a high crest (Text-fig. 14, *c*). Fifth thoracic segments produced laterally into sharp points. Segmentation between fourth and fifth thoracic segments faintly indicated. Abdomen (Text-fig. 14, *b*) long, $3\frac{3}{4}$ times in the total length of the cephalothorax. Genital segment equal to the three following segments without the furca, narrowed anteriorly and slightly asymmetrical, the right side being slightly swollen and carrying a postero-dorsal tooth or hook.



Text-fig. 15.—*Scolecocalanus lobatus*, n. sp. Female: *a*, dorsal view, × 25; *b*, head, lateral view, × 35; *c*, abdomen, lateral view, × 35; *d*, abdomen, dorsal view, × 43; *e*, rostral plate, × 100; *f*, antenna, × 59; *g*, second maxilla, × 100; *h*, maxillipede, × 59; *i*, first foot, × 75; *j*, second foot, × 59; *k*, fifth foot, × 155.

Antennules reaching to the middle of the genital segment, 23-jointed, joints 8–9 and 24–25 being fused. There is a partial fusing of the ninth and tenth joints. Antennae, mouth-parts and swimming-feet without diagnostic characters, being practically identical with those found in *Scottocalanus*, with the exception of the longitudinal row of spinules on the anterior face of the second and third joints of the endopodite of the fourth foot (Text-fig. 14, *f*). These spinules are also found in the genus *Macandrewella*.

Fifth foot (Text-fig. 14, *g*) present only on the left side and consisting of a short basal joint bearing a stout curved spine, which bears on its outer side, on the distal three-fourths,

a close-set row of fine cultriform spinules diminishing towards the tip of the spine, and a similar but finer row on the distal half of the inner side.

Scolecocalanus lobatus, n. sp. (Text-fig. 15.)

Occurrence.—Four females on Stn. 28, 600–0 m.

Description.—Female (Text-fig. 15, *a*), length 3·66 mm., with a moderately high crest (Text-fig. 15, *b*). Fifth thoracic segment produced laterally into acute points, partially separated from the fourth segment. Abdomen (Text-fig. 15, *c*, *d*) contained about 4·1 times in the length of the cephalothorax. Genital segment longer than the remaining abdominal segments and the furca taken together, with a dorso-lateral backwardly-directed lobe on its hinder margin. Rostral plate (Text-fig. 15, *e*) forked and ending in a pair of tapering rostral spines, which are about as long as the depth of the notch. Appendages (Text-fig. 15, *f*, *g*, *h*, *i*, *j*) similar to those of the preceding species, but the fifth foot (Text-fig. 15, *k*) is apparently without spinules on its inner side.

This species can be distinguished from *S. galeatus* by its smaller size, its less prominent crest, and the presence of a lobe on the genital segment.

Macandrewella.

A. Scott first proposed this genus in 1909 for *M. joanae* from the "Siboga" collections, and he included in it a male which had been described by Giesbrecht from the Red Sea under the name of *Scolecithrix chelipes*. Sewell described a third species, with both males and females, from the Indian Ocean. Three more species, apparently all different, were found in the Barrier Reef collections from outside the reef. One was common and readily recognizable by its asymmetrical fifth thoracic segment; the others, represented respectively by one and twelve specimens, resembled each other, and were separable mainly by the form of the genital segment.

The three genera *Scottocalanus*, *Macandrewella* and *Scolecocalanus* seem to form an allied group with *Scolecocalanus* in a middle position.

Macandrewella asymmetrica, n. sp. (Text-fig. 16.)

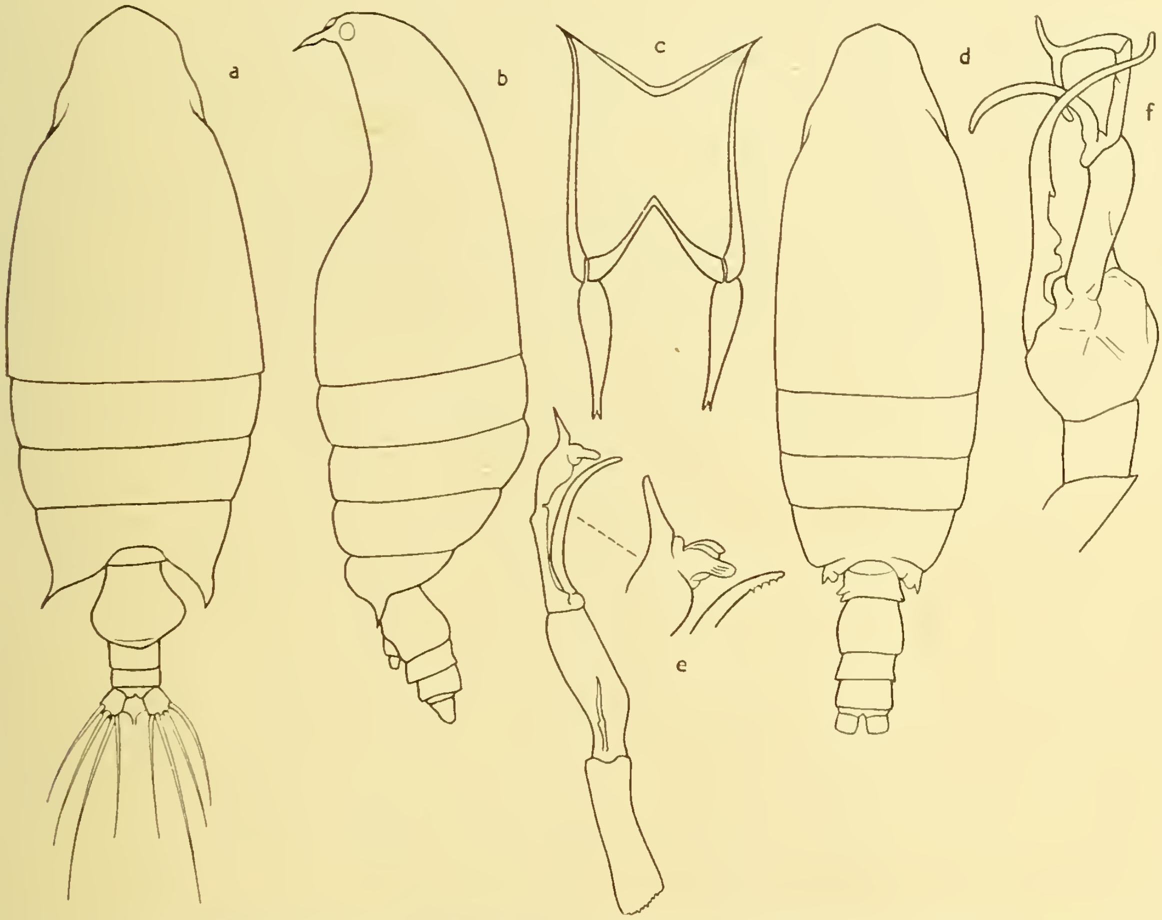
Occurrence.—Occurred in large or small numbers on four of the deep-water stations outside the reef. Absent from Stn. 28 and possibly from Stn. 45, on which one doubtful immature specimen was taken.

Stn. 19, S. 180–0 m., ♀ 17, ♂ 31, V 13; C. 180–0 m., ♀ 3, ♂ 5, V 80; 1 m. C. 180–0 m., ♀ 10, ♂ 11, V 36. Stn. 20, N. 250–0 m., ♀ 4, ♂ 2. Stn. 29, bottom stramin net, 205 m., ♀ 51, ♂ 258, V 11. Stn. 45, S. 500–0 m., V ? 1. Stn. 50, S. 400–0 m., ♀ 2, ♂ 4; C. 150–0 m., V ? 1. Most numerous at the lesser depths, especially on Stn. 29 when the net was actually at the bottom.

Description.—Female (Text-fig. 16, *a*, *b*), length 3·50–3·70 mm. Cephalon fused with first thoracic segment. Fourth and fifth thoracic segments separated ventrally. Fifth thoracic segment ending on either side in a sharp point, that on the right directed straight backwards, that on the left bent outwards at an angle of about 45°. Rostrum (Text-fig. 16, *c*) consists of a swollen plate, as in *Scottocalanus*, deeply notched at the tip and produced into sensory filaments, which are more than half as long as the rostral

plate : at the base of the rostral plate there is a median lenticular thickening. Genital segment asymmetrical, with swollen lateral projection on the right side, slightly overlapping the following segment dorsally and with a ventral backwardly-directed thumb-like process projecting from the genital boss. Furcal rami about as broad as long, with symmetrical setae.

Antennules reaching to the hinder end of the genital segment ; joints 8, 9 and 24–25 fused, partial fusion of joints 9 and 10. Proportional length of joints approximately as in *Scottocalanus*.



TEXT-FIG. 16.—*Macandrewella asymmetrica*, n. sp. Female : *a*, dorsal view, × 25 ; *b*, lateral view, × 25 ; *c*, rostral plate, × 253. Male : *d*, dorsal view, × 25 ; *e*, left fifth foot, × 43 ; *f*, right fifth foot, × 43.

First foot with outer edge spines on the first and second joints of the exopodite ; outer margin of the third joint straight. Second foot with outer margin of first basal joint notched and bearing a small tooth ; first joint of the exopodite with a curved outer edge spine, second joint with a transverse distal row of fine spinules, third joint with a few small spinules surrounding the proximal half of the face of the joint. Third foot with a small tooth on the outer margin of the first basal joint, second joint of the exopodite with a transverse distal row of fine spinules, third joint with a few very minute spinules on the face of the joint. Fourth foot with the outer margin of the first basal joint smooth, the face of the exopodite without spinules. Fifth feet absent.

Male (Text-fig. 16, *d*), length 3·7 mm. Cephalothorax in mid-dorsal line 2·8 mm., abdomen ·85 mm. Fifth thoracic segment ending laterally in short sharp points. The fifth pair of feet are very like those figured by Scott for *M. joanae* and differ only in small details, which can be best seen by comparison of the figures (Text-fig. 16, *e* and *f*, and Scott, 1909, pl. xxiii, fig. 14). This resemblance justifies the inclusion of this species in the genus *Macandrewella*, although the fifth thoracic segment of the female lacks the characteristic facies found in other species.

Macandrewella sewelli, n. sp. (Text-fig. 17.)

Occurrence.—In deep water outside the reef. Stn. 19, C. 180–0 m., ♀ 1 ; Stn. 29, stramin bottom net, 205 m., ♀ 5 ; Stn. 45, S. 500–0 m., ♀ 1 ; Stn. 50, S. 170–0 m., ♀ 1 ; S. 400–0 m., ♀ 4.

Description.—Female (Text-fig. 17, *a*, *b*), length 3·12–3·2 mm. Cephalon not separated from first thoracic segment; fourth and fifth thoracic segments separate but in dorsal view the separation is almost indistinguishable. Fifth thoracic segment ending laterally in a sharp point directed slightly inwards; dorsal and internal to these points there is a rather bluntly pointed ridge on each side. In front, ventrally, the fifth thoracic

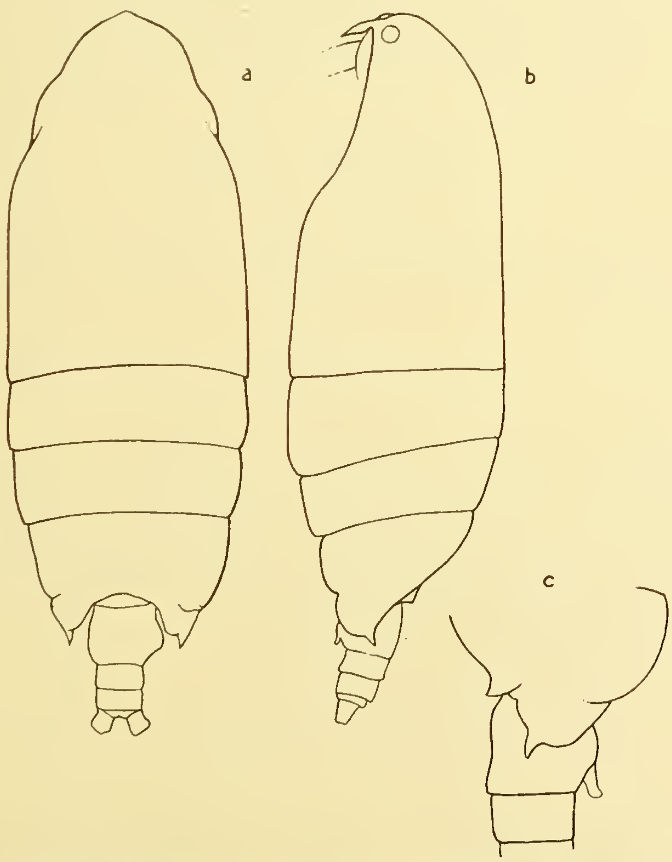
Text-fig. 17.—*Macandrewella sewelli*, n. sp. Female : *a*, dorsal view, × 28 ; *b*, lateral view, × 28 ; *c*, abdomen, lateral view, × 33 ; *d*, fifth thoracic and genital segments, dorso-lateral view, × 48.

segment is slightly produced into a blunt angle, which is sometimes rounded off and sometimes bears a small projection, as is shown in Text-fig 17, *c*. Abdomen (Text-fig. 17, *c*, *d*) about one-fourth of the length of the cephalothorax in the mid-dorsal line; abdominal segments and furca in the proportion 38 : 18 : 14 : 2 : 13. The abdomen is symmetrical except for a low dorso-lateral lobe on the right side of the hinder margin of the genital segment. Anal segment almost concealed by the preceding segment. Front of genital segment without the finger-like process which occurs in some other species of the genus. Furcal rami as broad as long, with four long subequal terminal setae, sometimes branched. Rostrum of a swollen forked plate ending in a short tapered filament on each side. Distinctly marked lenticular spot at the base of the rostrum. Antennules reaching to the end of the genital segment, with joints 8–10 and 24–25 fused, but with an indication of segmentation between joints 9 and 10. Antennae as in *M. joanae* with endopodite proportionally shorter than in *M. scotti*, but with the basal fringe of setae figured by Sewell for that species.

Macandrewella mera, n. sp. (Text-fig. 18.)

Occurrence.—One female in the stramin bottom net at Stn. 29, 209 m.

Description.—Female (Text-fig. 18, *a*, *b*), length 3·84 mm. Cephalothorax, in mid-dorsal line, 3·00 mm., in lateral view, 3·3 mm. Abdomen ·70 mm. Fourth and fifth thoracic segments not completely separated, fifth segment ending laterally in short



Text-fig. 18.—*Macandrewella mera*, n. sp. Female: *a*, dorsal view, × 25; *b*, lateral view, × 25; fifth thoracic and genital segments, lateral view, × 43.

sharp points directed slightly inwards. Dorsal to the point on the right side the margin of the segment (Text-fig. 18, *c*) is produced into a short tooth, which bears a few spinules on its margin. Rostrum an inflated bifurcate plate, ending in a pair of short filaments. There is a well-marked lenticular spot at the base of the rostrum.

Abdominal segments in the proportion of 40 : 17 : 12 : 3 : 15. Genital segment asymmetrical, with a swelling on the right side ; ventrally it bears a thumb-like projection directed backwards from the genital plate. Furcal setae similar on both rami, their lengths in mm. from without inwards being ·68, ·78, 1·08, ·56, ·13.

Cephalic appendages and swimming feet similar to those of *M. asymmetrica* and *M. sewelli* ; some small differences were noticed in the size and arrangement of the spinules on the faces of the endopodites of the swimming-feet, but it is unlikely that they have any specific value. Fifth feet absent.

Remarks.—Of the five females that have been referred to the genus *Macandrewella* the ventral thumb-like process on the genital segment is present in *M. joanae, M. mera* and *M. asymmetrica,* but absent in *M. scotti* and *M. sewelli.* The genital segment is described as symmetrical in *M. joanae* and *M. scotti,* but is asymmetrical in the three species here described. In *M. asymmetrica* and *M. mera* the asymmetry consists in a lateral swelling on the right side. In *M. sewelli* there is a dorso-lateral projection partially overlapping the following segment. *M. joanae* differs from all the other species in having a minute pair of fifth feet, an elongated seta on the right furca, and in the presence of spinules on the face of the third joint of the exopodite of the fourth feet. There is a marked similarity between the fifth thoracic segments of all except *M. asymmetrica,* in which the lateral thoracic points suggest at first sight the genus *Gaidius* rather than *Macandrewella.*

Centropages calaninus (Dana).

Giesbrecht, 1892.

Occurrence.—A single specimen, male, on Stn. 20, 250–0 m., outside the reef.

Length : ♂, 1·92 mm.

Centropages furcatus (Dana).

Giesbrecht, 1892.

Occurrence.—The most frequent species of *Centropages* in the collection, occurring on eighteen stations either at 3 mi. E. or in the reef passages. It also occurred in small numbers outside the reef, probably having been taken near the surface during the hauling of the deep-water nets, as follows : Stn. 19, S. 180–0 m., 1. Stn. 45, 500–0 m., 6. Stn. 50, S. 170–0 m., 1 ; S. 400–0 m., 2 ; C. 150–0 m., 72.

Length : ♀, 1·68–1·83 mm. ; ♂, 1·60 mm.

Centropages gracilis (Dana).

Giesbrecht, 1892.

Occurrence.—A scarce species only occurring on three stations at 3 mi. E. and on one, Stn. 19, just outside the reef.

Length : ♀, 1·92–2·04 mm.

Centropages orsinii, Giesbr.

Giesbrecht, 1892.

Occurrence.—Taken on five stations inside the reef and two, Stns. 45 and 50, outside, eighteen specimens in all.

Length : ♀, 1·20–1·56 mm. ; ♂, 1·20–1·38 mm. A wide range of sizes was noticeable in both sexes.

Temora discaudata, Giesbr.

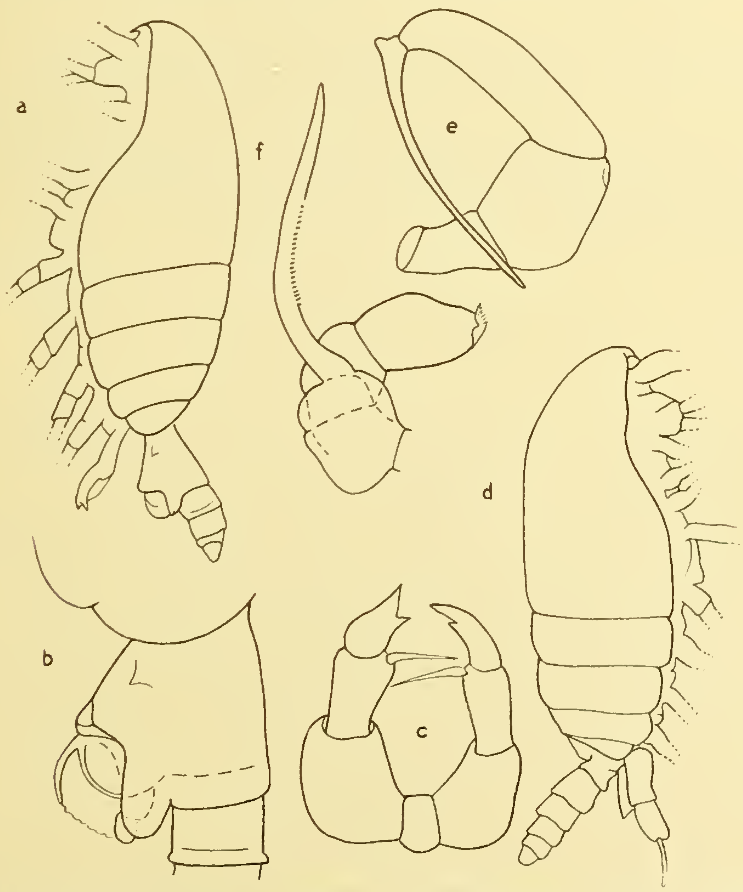
Giesbrecht, 1892.

Occurrence.—On the stations at 3 mi. E. this was a frequent species from the end of December to the end of May, but was very scarce before and after these dates, though outside the reef it seems to have been present in small numbers on all occasions when townettings were made there. Its period of scarcity coincided with that of high surface salinity over the reef.

Temora turbinata (Dana).

Giesbrecht, 1892.

Occurrence.—Not found inside the reef and only taken on two of the deep-water stations outside—Stn. 45, one female, and Stn. 50, two males and one female.



Text-fig. 19.—*Temoropia mayumbaensis*. Female : *a*, lateral view, × 84 ; *b*, genital segment, lateral view, × 247 ; *c*, fifth feet, × 247. Male : *d*, lateral view, × 84 ; *e*, right fifth foot, × 247 ; *f*, left fifth foot, × 247.

Temoropia mayumbaensis, T. Scott. (Text-fig. 19.)

T. Scott, 1894.

Occurrence.—Taken in small numbers on three of the deep-water stations—Stn. 20, 250–0 m., Stn. 28, 600–0 m., and Stn. 45, 500–0 m.

Length : ♀ (Text-fig. 19, *a*), ·70–·92 mm. ; ♂ (Text-fig. 19, *d*), ·84 mm.

Remarks.—There seem to be distinct differences, probably of specific value, between the fifth feet of the various forms which have been recorded under this name. The fifth feet of the present specimens resemble rather closely those originally figured by T. Scott (1894) from the Gulf of Guinea and also those of a specimen from the "Siboga" Expedition, a preparation of which was kindly lent to me by the late Mr. A. Scott. In these the endopodite consists of a single unjointed spine without an accessory seta, the joints are thick and massive, and the terminal joint on the right side is widely notched. The left foot is slightly more slender than the right and has a narrower terminal notch.

The male also shows a fairly close agreement with Scott's figures. The notched and ciliated tip of the left fifth foot, which is shown in his figure as flattened out, is shown in Text-fig. 19, *f*, as turned back over the terminal joint.

Metridia venusta, Giesbr.

Giesbrecht, 1892.

Occurrence.—Only three specimens were seen : Stn. 28, 600–0 m., two females, apparently dead when taken, and Stn. 45, 500–0 m., one female.

Length : ♀, 2·65–3·05 mm.

Pleuromamma abdominalis (Lubb.).

Steuer, 1932.

Occurrence.—(Typical form) Stn. 28, C. 600–0 m., ♀ 1 ; S. 600–0 m., ♀ 8, ♂ 5. Stn. 45, C. 500–0 m., ♀ 1. Stn. 50, S. 400–0 m., ♀ 2, ♂ 1.

Var. *abyssalis* : Stn. 19, C. 180–0 m., ♀ 2 ; C. (1 m.), 180–0 m., ♀ 1. Stn. 28, C. 600–0 m., ♀ 5, ♂ 1 ; S. 600–0 m., ♀ 5, ♂ 2. Stn. 29, bottom stramin net, 205 m., ♀ 1. Stn. 45, C. 500–0 m., ♀ 2, ♂ 4. Stn. 50, S. 400–0 m., ♀ 1, ♂ 6.

Remarks.—The specimens of *P. abdominalis*, which were taken only in vertical hauls from deep water outside the reef, fall, both males and females, into two size-groups, females 2·52–2·76 mm. and 2·95–3·06 mm., and males 2·40–2·68 mm. and 2·76–3·21 mm. The larger males were asymmetrical and of the typical *P. abdominalis* form ; the smaller agreed with the var. *abyssalis*, which has been described in detail and discussed by Steuer (1932) in his monograph of the genus. The female of the var. *abyssalis* has not yet been described, and I assume that it is represented by the smaller specimens which did not show any appreciable difference in form of body or appendages from the larger females of the typical form. There was no indication that the smaller group was more abyssal in its habitat than the larger.

Pleuromamma xiphias (Giesbr.).

Steuer, 1932.

Occurrence.—Only taken on stations on which nets were fished down to 400 m. or more. Stn. 28. S. 600–0 m., ♀ 4, V 3; C. 600–0 m., V 3. Stn. 45, S. 500–0 m., V 1; C. 500–0 m., V 1. Stn. 50. S. 400–0 m., ♂ 1. V 4.

Length: ♀, 4·08–4·40 mm.

Pleuromamma gracilis (Lubb.).

Steuer, 1932.

Occurrence.—A few specimens were taken on three of the deep-water stations outside the reef: Stn. 20, N. 250–0 m., ♀ 1. Stn. 28, C. 600–0 m., ♀ 14. Stn. 45, C. 500–0 m., ♀ 2.

Length: ♀, 1·61–1·72 mm.

Remarks.—The slender abdomen of the female, the subequal spines on the fifth feet and the small size mark these specimens as belonging to Steuer's (1932) forma *minima*.

Pleuromamma piseki. Farran.

Pleuromamma gracilis forma *piseki*, Steuer, 1932.

Occurrence.—Taken outside the reef in about the same numbers as *P. gracilis*, and in company with it on two stations. Stn. 19, C. 180–0 m., ♀ 2. Stn. 28, C. 600–0 m., ♀ 8. Stn. 45, S. 500–0 m., ♀ 1; C. 500–0 m., ♀ 1.

Length: ♀, 1·71–1·84 mm.

Remarks.—A few immature specimens were taken which may have belonged either to *P. gracilis* or *P. piseki*. Four males were found on Stn. 28 and one on Stn. 45, but it is doubtful to which species they should be referred.

Lucicutia flavicornis (Claus).

Giesbrecht, 1892.

Occurrence.—Taken only outside the reef, probably at moderate depths, in moderate numbers. Stn. 19, N. 180–0 m., 3; 1 m. C. 180–0 m. 1. Stn. 20, N. 250–0 m., 10. Stn. 28, N. 600–0 m., 13. Stn. 45, N. 500–0 m., 14. Stn. 50, N. 150–0 m., *ca.* 40.

Remarks.—Most of the specimens were of small size, ♀ 1·3–1·4 mm., but on Stn. 20 there were a few distinctly larger, ♀ 1·63–1·80 mm., ♂ 1·68 mm., in company with the smaller specimens. The antennules seemed to be proportionately longer and also the longest furcal seta, but the other appendages agreed very well with those of *L. flavicornis*, and without further knowledge of the range of variation in this species it would be unwise to regard them as being more than well-grown specimens.

Lucicutia gemina, Farran.

Farran, 1926.

Occurrence.—Taken in company with *L. flavicornis* on three stations outside the reef. Stn. 20, N. 250–0 m., ♀ 1. Stn. 28, N. 600–0 m., ♀ 1. Stn. 45, N. 500–0 m., ♀ 1.

Length: ♀, 1·42–1·60 mm.

Remarks.—These specimens appear to be identical with those described from the Bay of Biscay, being distinguishable from *L. longicornis* by their smaller size and shorter antennules and from *L. flavicornis* by their longer furca with the rami close together and with a very small innermost seta, the outer margin of the exopodite of the fifth foot without serrulations and the noticeably smaller genital boss.

Lucicutia clausi (Giesbr.).

Giesbrecht, 1892.

Occurrence.—Taken in small numbers on two stations outside the reef: Stn. 19, C. 180–0 m., ♀ 1. Stn. 28, C. 600–0 m., ♀ 3, ♂ 2.

Length: ♀, 1·80–1·98 mm.; ♂, 1·85–1·92 mm.

Lucicutia ovalis, Wolfenden.

Wolfenden, 1911.

Occurrence.—Very few specimens were taken on four stations outside the reef: Stn. 19, C. 180–0 m., ♀ 1. Stn. 20, C. 250–0 m., ♂ 1. Stn. 28, C. 600–0 m., ♀ 1. Stn. 45, C. 500–0 m., ♀ 2.

Length: ♀, 1·25–1·41 mm.; ♂, 1·21 mm.

Remarks.—Readily recognizable by its small size, stout curved form, with large genital boss and short furca with short terminal setae.

Heterorhabdus papilliger (Claus).

Sars, 1925.

Occurrence.—In moderate numbers in four hauls made outside the reef—Stns. 19, 20, 28 and 45. Though these hauls were made vertically from deep water, the specimens were probably taken in the upper layers.

Length: ♀, 1·72–1·80 mm.; ♂, 1·80 mm.

Heterorhabdus spinifrons (Claus).

Sars, 1925.

Occurrence.—In three hauls from deep water outside the reef.: Stn. 28, C. 600–0 m., ♀ 10; S. 600–0 m., ♂ 1. Stn. 45, C. 500–0 m., ♀ 1, imm. 1.

Length: ♀, 2·14 mm.; ♂, 3·14 mm.

Remarks.—Probably a deep-water species here as elsewhere, as it did not occur in hauls from less than 500 m.

Haloptilus spiniceps (Giesbr.)

Hemicalanus spiniceps, Giesbrecht, 1892.

Occurrence.—Three adult females and one immature specimen were taken outside the reef on Stn. 19, S. 180–0 m.

Length: ♀, 4·02 mm.

Haloptilus acutifrons (Giesbr.).

Hemicalanus acutifrons, Giesbrecht, 1892.

Occurrence.—One immature specimen outside the reef on Stn. 45, S. 500–0 m.
Length : ♀ V. 2·02 mm.

Haloptilus mucronatus (Claus).

Sars, 1925.

Occurrence.—One female was taken inside the reef. 3 mi. E., on Stn. 24. and two immature specimens on Stn. 50, S. 500–0 m., outside the reef.

Haloptilus angusticeps, G. O. Sars.

G. O. Sars, 1925.

Occurrence.—One immature female, stage V. which appeared to belong to this species was taken on Stn. 45. S. 500–0 m.. outside the reef.

Length : ♀ V, 3·03 mm.

Remarks.—The specimen agreed closely in general appearance with Sars' (1924) figure of the adult. The anterior caecum occupies almost the whole cephalon and the spines of the second maxilla were subequal. The endopodite of the maxilla was, however, only 2-jointed, with four and five spines on the joints, while the adult has a 4-jointed endopodite. This difference may be due to the immaturity of the specimen. The species was originally recorded from the Mediterranean and Madeira.

Haloptilus longicornis (Claus).

G. O. Sars, 1903.

Occurrence.—Occurred in moderate numbers in almost every townetting taken outside the reef.

Length : ♀, 1·98–2·45 mm.

Augaptilus longicaudatus (Claus).

Giesbrecht, 1892.

Occurrence.—Three specimens, a male and two females, were taken on three stations outside the reef.

Length : ♀, 3·72 mm.

Augaptilus spinifrons, G. O. Sars.

G. O. Sars, 1925.

Occurrence.—A single female was taken on Stn. 28, outside the reef, N. 600–0 m.

Length : ♀, 3·0 mm.

It had previously been recorded only from the Azores and off Gibraltar.

Euaugaptilus filigerus (Claus).

Augaptilus filigerus, Giesbrecht, 1892.

Occurrence.—Two females from deep water outside the reef. Stn. 28, S. 600–0 m., ♀ 1. Stn. 45, N. 500–0 m., ♀ 1.

Length: ♀, 5·4 mm.

Euaugaptilus palumboi (Giesbr.).

Augaptilus palumboi, Giesbrecht, 1892.

Occurrence.—Two specimens, both immature, were taken on the same stations as *E. filigerus*.

Candacia aethiopica, Dana.

Candace aethiopica, Giesbrecht, 1892.

Occurrence.—Very scarce. Three specimens on two stations, 6 and 14, at 3 mi. E., and one outside the reef. Stn. 19, 1 m. C., 180–0 m.

Length: ♀, 2·40–2·52 mm.

Candacia discaudata, A. Scott.

A. Scott, 1909.

Occurrence.—The most plentiful species of *Candacia* in the collection, both on the reef, which seems to be its main habitat, and in hauls made outside over deep water.

Inside the reef it was taken on forty-three stations. Outside the reef it was scarce, occurring in small numbers on Stns. 45 and 50 only.

Length: ♀, 1·60–1·82 mm.; ♂, 1·52–1·82 mm.

Remarks.—Although only described in 1909 by A. Scott, this appears to be one of the most characteristic copepods of inshore waters from India to Australia. After *C. pachydactyla*, *C. simplex* and *C. truncata* it was commonest on the Malay Peninsula, and Sewell (1912, 1914) found it numerous on the Burman coast and the Ceylon pearl paars. Carl (1907) records it from Amboyna.

Candacia curta, Dana.

Candace curta, Giesbrecht, 1892.

Occurrence.—On two stations outside the reef. Stn. 28, N., 600–0 m., ♂ 2; S. 600–0 m., ♀ 1. Stn. 29, bottom stramin net, 205 m., ♀ 1.

Length: ♀, 2·35 mm.; ♂, 2·28 mm.

Candacia bispinosa, Claus.

Candace bispinosa, Giesbrecht, 1892.

Occurrence.—Once at 3 mi. E., Stn. 51, once in the reef passages, Stn. 11, and several specimens on most of the stations outside the reef—Stns. 19, 28, 45, 51.

Length: ♀, 1·56–1·72 mm.; ♂, 1·68–1·76 mm.

Candacia simplex, Giesbr.

Candace simplex, Giesbrecht, 1892.

Occurrence.—On two stations outside the reef: Stn. 19, N., 180–0 m., ♀ 1; S. 180–0 m., ♀ 2, ♂ 1. Stn. 28, N. 600–0 m., ♀ 4; S. 600–0 m., ♀ 1, ♂ 1.

Length: ♀, 1·62–1·92 mm.; ♂, 2·04–2·20 mm.

Candacia truncata, Dana.

Candace truncata, Giesbrecht, 1892.

Occurrence.—On four stations outside the reef and once, one specimen, probably drifted in, at 3 mi. E., Stn. 24: Stn. 19, N. 180–0 m., ♀ 1, ♂ 1; S. 180–0 m., ♀ 7, ♂ 7. Stn. 20, N. 250–0 m., ♀ 3, ♂ 3. Stn. 28, N. 580–0 m., ♀ 2; S. 600–0 m., ♀ 2, V 2. Stn. 45, N. 500–0 m., ♀ 1.

Length: ♀, 1·85–2·04 mm.

Candacia catula, Giesbr.

Candace catula, Giesbrecht, 1892.

Occurrence.—One specimen, a male, on Stn. 28, S. 600–0 m.

Length: ♂, 1·32 mm.

Candacia longimana, Claus.

Candace longimana, Giesbrecht, 1892.

Occurrence.—On three stations outside the reef, two to five specimens on each: Stn. 19, S. 180–0 m., ♀ 2, ♂ 3. Stn. 20, N. 250–0 m., ♀ 1, ♂ 1. Stn. 50, S. 400–0 m., ♀ 1, ♂ 1.

Length: ♀, 2·95–3·25 mm.; ♂, 2·45–3·24 mm.

Calanopia elliptica (Dana).

A. Scott, 1909.

Occurrence.—Its main habitat is inside the reef, where it occurred in 33 townettings at 3 mi. E. It was also found on two stations, 45 and 50, outside the reef.

Length: ♀, 1·75–1·97 mm.; ♂, 1·60–1·80 mm.

Calanopia aurivillii, Cleve.

A. Scott, 1909.

Occurrence.—Much scarcer than *C. elliptica*, occurring on only five stations, 4, 7, 10, 62, 65, inside the reef, and on three over deep water: Stn. 19, N. 180–0 m., ♂ 2. Stn. 45, N. 500–0 m., ♀ 27, ♂ 11, V 1. Stn. 50, S. 170–0 m., ♀ 2, ♂ 1; N. 150–0 m., ♀ 4, ♂ 1. It is evidently more oceanic in its habitat than *C. elliptica*.

Length; ♀, 1·27–1·32 mm.; ♂, 1·17–1·18 mm.

Labidocera acutifrons (Dana).

Giesbrecht, 1892.

OCCURRENCE.—Taken at four stations, 14, 15, 16 and 18, at 3 mi. E., one or two specimens on each station. There seems to have been an incursion of the species between 26th September and 15th October from some source not explored.

Length : ♀, 3·36–3·55 mm. ; ♂, 3·30–3·48 mm.

Labidocera acuta (Dana).

Giesbrecht, 1892.

OCCURRENCE.—Occasionally at 3 mi. E. up to the end of December, 1928. After that date it became frequent, occurring on almost every station. It was taken twice in the reef passages, and on one station (Stn. 50) over deep water.

Labidocera minuta, Giesbr.

Giesbrecht, 1892.

OCCURRENCE.—Taken on three stations at 3 mi. E., four specimens in all, and on two (Stns. 45 and 50) over deep water in moderate numbers. It seems probable that its normal habitat is outside the reef. It should be noted that the hauls outside the reef, being vertical hauls from deep water, were not adapted to the capture of surface-living forms, such as *Labidocera* and *Pontella*.

Length : ♀, 1·76–2·26 mm. ; ♂, 1·68 mm.

Labidocera laevidentata (Brady).

A. Scott, 1909.

OCCURRENCE.—This scarce species was only found on two occasions at 3 mi. E., Stns. 22 and 48, three specimens in all.

Length : ♀, 1·95 mm.

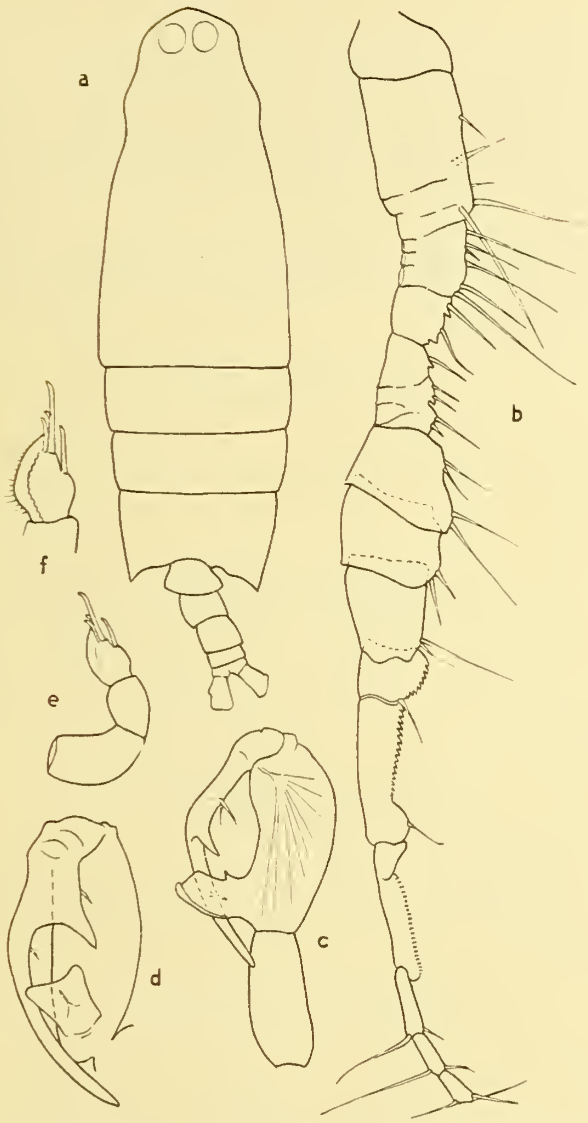
Labidocera, sp. (Text-fig. 20.)

OCCURRENCE.—Six specimens, all males, on four stations at 3 mi. E.—Stns. 2, 3, 6 and 63.

Length : ♂ (Text-fig. 20, *a*), 3·12–3·18 mm.

REMARKS.—I have not been able to identify these with any described males, though in some respects they come very near to the description of *L. pavo* from Ceylon given by Sewell (1914). They are, however, much larger and the antennules are different, joints 18 and 19 being each equal to 16 and 17 taken together, and the teeth on the upper edge of joint 19 are continued to the distal end of the joint. In the right fifth foot (Text-fig. 20, *c*, *d*) the terminal claw is flattened basally in a plane at right angles to that of the preceding joint.

I have not put a name to these specimens as they may turn out to be the males of some female already described.



TEXT-FIG. 20.—*Labidocera*, sp. Male : *a*, dorsal view, × 29 ; *b*, antennule, × 59 ; *c*, right fifth foot, × 51 ; *d*, the same, another view, × 60 ; *e*, left fifth foot, × 51 ; *f*, terminal joint of same.

Labidocera detruncata (Dana).

Giesbrecht, 1892.

OCCURRENCE.—Two specimens, a male and a female, were found in the surface haul of the serial townettings on Stn. 16 at 3 mi. E.

Length : ♀, 2·46 mm. ; ♂, 2·40 mm.

Pontella securifer, Brady.

Giesbrecht, 1892.

OCCURRENCE.—One specimen, a female, on the outer part of the reef on Stn. 26, Trinity Opening.

Length : ♀, 4·14 mm.

Pontella cristata, Krämer.

Krämer, 1896.

Occurrence.—One specimen, a male, taken at 3 mi. E. on Stn. 16, in the serial townetting at 10 m., and an immature female in the surface townetting on the same station.

Length : ♀, 4·14 mm.

Remarks.—This species, originally described by Krämer in 1896 from the coast of New South Wales, is easily recognized by the distinctive form of the male fifth feet.

Pontella fera, Dana.

Giesbrecht, 1892.

Occurrence.—One specimen, a female, on Stn. 36, 3 mi. E.

Length : ♀, 2·76 mm.

Pontella danae, Giesbr.

Giesbrecht, 1892.

Occurrence.—One specimen, a male, at 3 mi. E. in the serial townet at 40 m. on Stn. 16.

Length : ♂, 4·08 mm.

Pontellopsis regalis (Dana).

Monops regalis, Giesbrecht, 1892.

Occurrence.—One specimen, a female, at 3 mi. E. in the surface net on Stn. 16.

Length : ♀, 3·47 mm.

Pontellopsis krameri (Giesbr.).

Monops krameri, Giesbrecht, 1896.

Occurrence.—Taken on three stations inside the reef, Stns. 16, 35 and 41, and on Stn. 50 over deep water, six specimens in all. No males were seen.

Length : ♀, 1·92–2·16 mm.

Pontellopsis macronyx, A. Scott.

A. Scott, 1909.

Occurrence.—Four specimens, all males, were taken on three stations (Stns. 5, 14, and 16) at 3 mi. E.

Length : ♂, 1·68–2·04 mm.

Pontellina plumata (Dana).

Giesbrecht, 1892.

Occurrence.—Taken in small numbers on four stations (Stns. 19, 20, 28, 45) outside the reef and on three successive stations (Stns. 14, 15 and 16), at 3 mi. E. These last suggest that a chance incursion from outside had occurred.

Length : ♀, 1·68–1·72 mm. ; ♂, 1·45–1·50 mm.

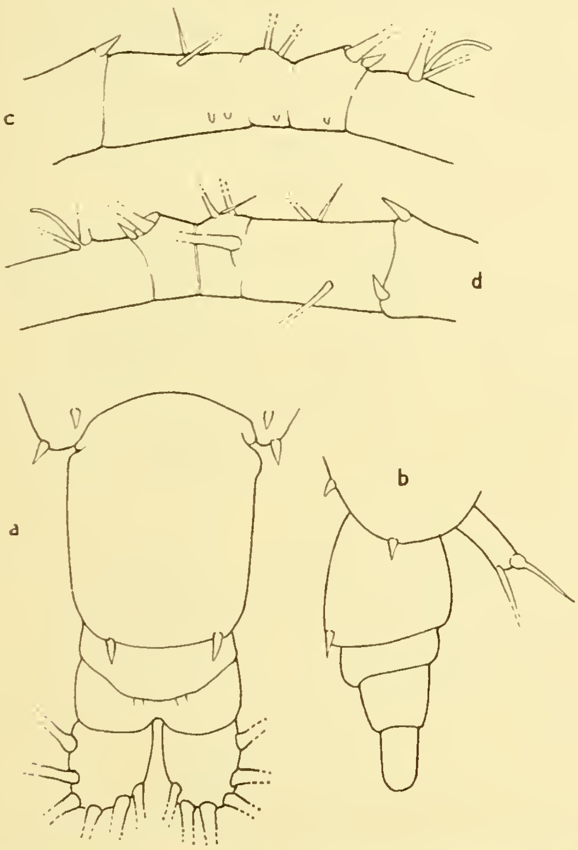
Acartia pietschmanni, Pesta. (Text-fig. 21.)

Steuer, 1923.

Occurrence.—One female on Stn. 50, outside the reef. Two immature females on Stn. 16 at 3 mi. E. and one immature female on Stn. 26, Trinity Opening.

Length : ♀, 1·24 mm.

Remarks.—The adult female from Stn. 50 (Text-fig. 21, *a–d*) had all the characters of this species, viz. fifth thoracic segment with two widely separated marginal teeth on



Text-fig. 21.—*Acartia pietschmanni.* Female : *a*, abdomen, dorsal view ; *b*, abdomen and fifth foot, lateral view ; *c*, basal joints of antennule, dorsal view ; *d*, same, ventral view.

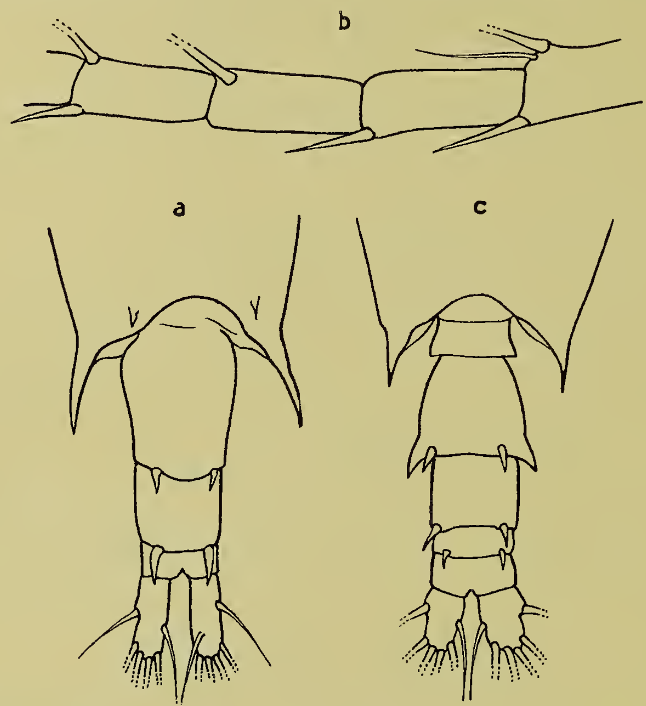
each side, genital segment with a spine on either side of the posterior dorsal margin, second abdominal segment with four minute granules on the posterior dorsal margin, antennules with a distal spine on the anterior margin of the first and fourth joints, some minute spinules near the posterior margin of the third and fourth joints, claw of fifth feet with a swollen base as in *A. clausi.* In addition there was a small distal spine on the ventral side of the first joint of the antennules near the posterior margin. In the immature specimens in Stage V the spines on the thoracic and genital segment and also the fifth feet were as in the adult ; in one specimen the spines on the genital segment were doubled. The spinules on the antennules and on the second abdominal segment were absent and the spines on the antennules much reduced or absent.

Acartia pacifica, Steuer. (Text-fig. 22.)

Steuer, 1923.

Occurrence.—Evidently one of the normal inhabitants inside the reef, as out of the period from which small specimens were available, viz. August and September, 1928, it was always present at 3 mi. E. in small or moderate numbers during the first half of August. It also occurred in the same locality in June and July, 1929, in the serial townettings. It was only once taken outside the reef, one specimen on Stn. 28.

Length : ♀ (Text-fig. 22, *a*), 1·32–1·34 mm. ; ♂ (Text-fig. 22, *c*), 1·26–1·30 mm.



Text-fig. 22.—*Acartia pacifica.* Female : *a*, abdomen, dorsal view ; *b*, antennule, 15th–18th joints. Male : *c*, abdomen, dorsal view.

Remarks.—The female is distinguishable by acute lateral prolongations of the fifth thoracic segment, comparatively long furcal rami, a pair of large spines on the posterior margin of the second abdominal segment and a pair of smaller spines on the posterior margin of the genital segment. There are slender spines on the fifteenth, sixteenth and eighteenth joints of the antennule (Text-fig. 22, *b*), and the terminal spine of the fifth foot has a small lobe at its base.

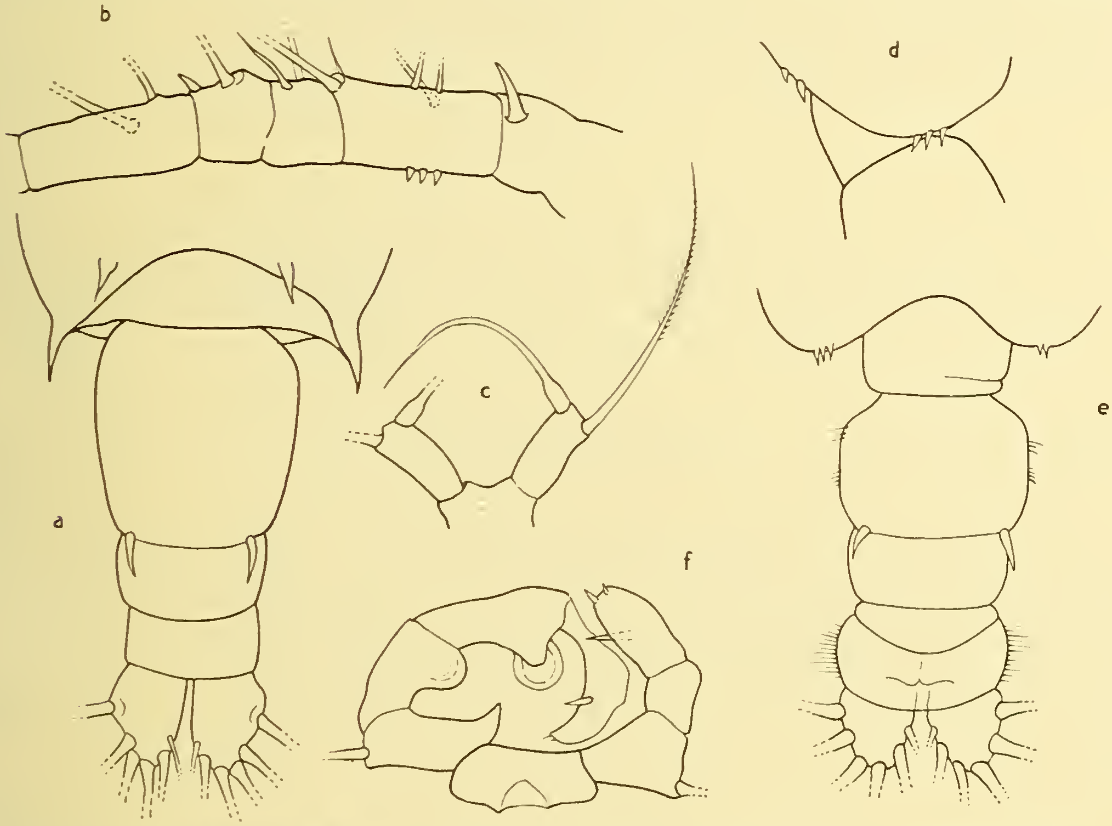
Acartia australis, n. sp. (Text-fig. 23.)

Occurrence.—Not taken at 3 mi. E. but occurred twice in Trinity Opening (Stns. 8, 26) and on three stations outside the reef : Stn. 28, N. 500–0 m., ♂ 5, ♀ 6 ; Stn. 45, N. 500–0 m., ♂ 5, ♀ 6 ; Stn. 50, S. 170–0 m., ♀ 1.

Description.—Female, length 1·30–1·34 mm. Form of the body as in *A. erythraea*, the fifth thoracic segment (Text-fig. 23, *a*) being prolonged laterally into an acute point, dorsal to which, on each side, on the margin of the segment, is a well-developed spine. On each side of the dorsal hinder edge of the genital segment is a strong spine more than

half as long as the following segment. Proportional length of the abdominal segments and furca 15 : 5 : 4 : 6, the furca being $1\frac{1}{5}$ times as long as wide. Second and third abdominal segments without spines or spinules.

First joint of the antennules (Text-fig. 23, *b*) with a stout, slightly curved, spine on its ventral face, nearer the upper than the lower margin. Second joint (aa 2–4) with three sharp spinules on its lower margin. On the upper edge of the fourth joint (aa 7–8) is a small spine at the distal end. The segmentation between the third and fourth joints



TEXT-FIG. 23.—*Acartia australis*, n. sp. Female : *a*, abdomen, dorsal view ; *b*, antennule, basal joints ; *c*, fifth feet. Male : *d*, fifth thoracic segment, lateral view ; *e*, abdomen, dorsal view ; *f*, fifth feet.

is not clearly defined. Rest of antennule without spines or spinules. Fifth feet (Text-fig. 23, *c*) almost exactly as in *A. bispinosa*, with basal joint about twice as long as wide, a long curved spine basally thickened and about three times as long as the basal joint, and a feathered seta as long as the spine.

Male, length 1·13 mm. Fifth thoracic segment (Text-fig. 23, *d*) rounded laterally and ending in two or three small marginal spines on each side, dorsal to which on the lateral margin are a small and a very small spine. Genital segment (Text-fig. 23, *e*) very slightly setose laterally and with a stout spine dorsally on either side of the posterior margin. The two following segments are without setae or spines, but the anal segment has its sides setose. Furca about as wide as long. Fifth feet (Text-fig. 23, *f*) resemble those of *A. bispinosa*, with rounded lobes on the inner margin of the third and fourth joints.

Remarks.—This species falls into Steuer's sub-genus *Odontacartia,* and of the seven species included by Steuer (1923) in the subgenus it is most closely allied to *A. bispinosa* and *A. erythraea* but, amongst other differences, those two species have two spines on the first joint of the antennules.

Acartia danae, Giesbr.

Giesbrecht, 1892.

Occurrence.—Once at 3 mi. E. Stn. 14, ♀ 1, once inside Cook's Passage, Stn. 46, ♀ 1, and in moderate numbers on the stations outside the reef.

Length : ♀, 1·15–1·19 mm. ; ♂, ·9 mm.

Acartia negligens, Dana.

Giesbrecht, 1892.

Occurrence.—Taken frequently both on the stations on the reef, mainly on those from which small specimens were available, and also on the stations outside the reef. It was the most plentiful species of *Acartia* in the collection, but was never abundant.

Length : ♀, 1·70–2·07 mm. ; ♂, 1·44–1·50 mm.

Tortanus gracilis (Brady).

Steuer, 1926.

Occurrence.—On the stations inside the reef it was only found singly or in small numbers and then only between 26th February and 18th July, 1929, being absent from the samples from 27th July, 1928, to 18th February, 1929. The only occasion on which it was taken in considerable numbers was on the serial station 62 in June, 1929, where it amounted to a little over 1% of the total number of copepods. On the stations outside the reef only four specimens were taken, one on Stn. 45, and three in three separate hauls on Stn. 50. It seems to be a local reef species, occasionally extending its range to the waters outside.

Length : ♀, 1·70–2·07 mm. ; ♂, 1·44–1·50 mm. The largest female specimens were taken on the outside stations. They measured 1·98–2·07 mm. None of the reef specimens exceeded 1·98 mm.

Harpacticoida.

Clytemnestra rostrata, Brady.

Giesbrecht, 1892.

Occurrence.—One female, length ·87 mm., was taken outside the reef on Stn. 50, 150–0 m.

Clytemnestra scutellata, Dana.

Giesbrecht, 1892.

Occurrence.—Eleven specimens in all were seen, six of them from outside the reef, Stns. 19, 20 and 28, and five from the serial townettings on Stns. 62, 65 and 68 at 3 mi. E.

Length : ♀, ·80–1·10 mm. ; ♂, ·80–1·20 mm. The reef specimens, with the exception of a male of 1·15 mm., were all between ·8 and ·9 mm. The specimens from outside the reef measured from 1·05–1·20 mm.

Euterpina acutifrons (Dana).

Euterpe acutifrons, Giesbrecht, 1892.

Occurrence.—Occurred in very small numbers inside the reef. Probably it was too small to be taken, except accidentally, in the townets which were used.

Setella gracilis, Dana.

Giesbrecht, 1892.

Occurrence.—Taken in small or moderate numbers on sixteen stations inside the reef and on all the stations outside. The serial townettings indicated that it was mainly a surface form.

Length : ♀, 1·25–1·52 mm. ; ♂, 1·08–1·20 mm.

Microsetella norvegica (Boeck).

Microsetella atlantica, Giesbrecht, 1892.

Occurrence.—Three specimens were seen, one from inside the reef and two from outside.

Length : ♀, ·50 mm. : ♂, ·51 mm.

Remarks.—Like *Euterpina acutifrons*, this species is too small to be taken normally in the nets used, and the numbers seen had probably little or no relation to those actually present.

Aegisthus mucronatus, Giesbr.

Giesbrecht, 1892.

Occurrence.—One dead specimen, a female, was taken on Stn. 28, N. 600–0 m. The body, without the furca, measured 2·16 mm., the broken furca 5·64 mm.

Cyclopoida.

Oithona plumifera, Baird.

Rosendorn, 1917.

Occurrence.—Occurred practically in every townetting in the collection ; occasionally the most abundant species in the fine-meshed nets, but usually in somewhat smaller numbers than *Paracalanus aculeatus*.

Length : ♀, 1·10–1·22 mm.

Remarks.—All these specimens have been recorded as *O. plumifera*, as all that were examined had only three setae on the endopodite of the mandible and a very minute seta on the endopodite of the first maxilla, although the presence of plumose setae on the basals of the swimming-feet could not always be made out.

Oithona tenuis, Rosendorn.

Rosendorn, 1917.

Occurrence.—A few specimens were found in four townettings from 3 mi. E., Stns. 10, 11, 13, 15, but its main habitat seems to be outside the reef, where it occurred on all the stations in small or moderate numbers.

Length : ♀, 1·16–1·25 mm.

Oithona setigera (Dana).

Rosendorn, 1917.

Occurrence.—Two specimens only were found in townettings inside the reef, but outside the reef it was moderately common on all the stations.

Length : ♀, 1·32–2·04 mm.

Remarks.—The wide range of sizes present suggests that there may be a large and a small form, the latter very scarce, but enough specimens were not available to show that two definite size-groups were present.

Oithona similis, Claus.

Rosendorn, 1917.

Occurrence.—Found both inside the reef, two stations, Stns. 11 and 16, and outside, three stations, Stns. 19, 20 and 28, but in very small numbers.

Length : ♀, ·90–·93 mm.

Oithona robusta, Giesbr.

Rosendorn, 1917.

Occurrence.—Only taken on the stations outside the reef, in small numbers.

Length : ♀, 1·56–1·60 mm.

Oithona attenuata, Farran.

Rosendorn, 1917.

Occurrence.—Apparently very scarce. Two specimens were found inside the reef, at Stns. 10 and 68, and five outside, on Stn. 50.

Length : ♀, 1·78 mm.

Oithona rigida, Giesbr.

Rosendorn, 1917.

Occurrence.—This seems to be a moderately common form, as it occurred in small numbers, both inside the reef and outside it, in most of the gatherings with nets capable of retaining it from which adequate samples were available.

Length : ♀, ·70–·86 mm.

Mormonilla phasma, Giesbr.

Giesbrecht, 1892.

Occurrence.—Five specimens, females, were taken outside the reef, on Stn. 28, N. 600–0 m.

Length : ♀, 1·28–1·40 mm.

Mormonilla minor, Giesbr.

Giesbrecht, 1892.

Occurrence.—Six specimens, females, were taken in the same haul as *M. phasma*, Stn. 28.

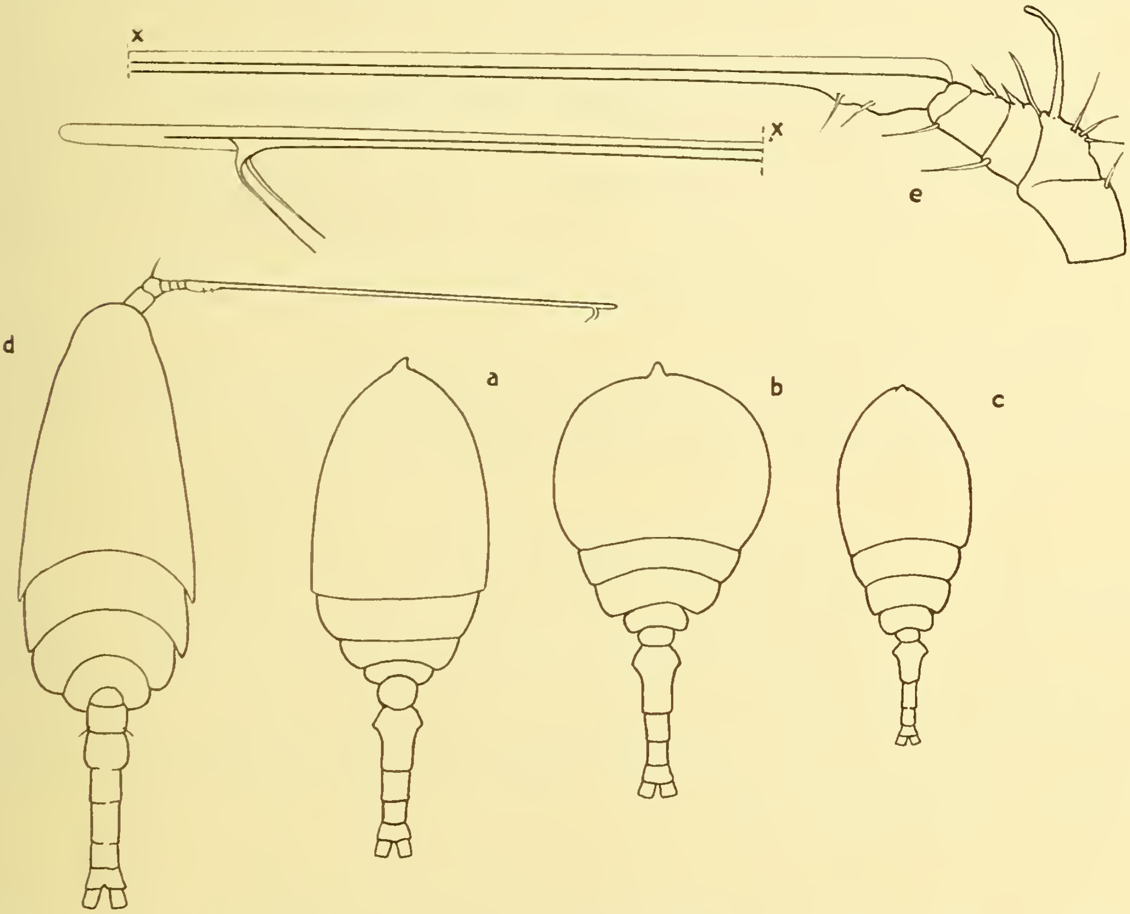
Length : ♀, 1·08–1·12 mm.

Pontoeciella abyssicola. T. Scott. (Text-fig. 24.)

Giesbrecht, 1899.

Occurrence.—Stn. 19, N. 180–0 m., ♂ 1. Stn. 20, N. 250–0 m., ♂ 2, V 2. Stn. 28, N. 580–0 m., ♀ 2. Stn. 45, N. 500–0 m., ♀ 1. Stn. 48 (3 mi. E.), C. 38–0 m., ♀ 1.

Remarks.—The specimens, as regards the form of the cephalothorax, belonged to three different types, which I have figured. Stn. 20, two immature specimens, length ·85 mm., with medium cephalon, width 37% of the total length of the animal. Stn. 28, two females (Text-fig. 24, *b*), length ·83 mm., width of cephalon 41% of total length;



Text-fig. 24.—*Pontoeciella abyssicola.* Female: *a*, dorsal view (Stn. 45), × 69; *b*, dorsal view (Stn. 28), × 69; *c*, dorsal view (Stn. 24), × 69. Male: *d*, dorsal view, × 80; *e*, antennule, × 267.

one of these had an abnormal third foot on one side with two outer edge spines on the second joint of the exopodite. Stn. 45, one female (Text-fig. 24, *a*), length ·93 mm., width of cephalon 37% of total length. The right first foot of this specimen had a double outer edge spine on the third joint as figured by Giesbrecht (1899). The corresponding left foot had only a single spine in this position. Stn. 48, one female (Text-fig. 24, *c*), length ·70 mm., width of cephalon 33% of total length. All these specimens had a projection on the outer edge of the first joint of the endopodite of the fourth foot similar to what is found on the corresponding joints of the first to third feet. In the specimen

from Stn. 48 it was not strongly marked ; in that from Stn. 28 it was very distinct. In Giesbrecht's figure of the fourth foot (1899) it is barely indicated. These specimens support the view held by Giesbrecht that this species shows great variation in the relative width of the carapace. The variation also extends, apparently, in small details to the form of the appendages.

The male (Text-fig. 24, *d*) of this species, which has been briefly described and in part figured by T. Scott (1894), differs from the female in some points which call for special notice. The siphon is absent. The antennules (Text-fig. 24, *e*) are apparently 6-jointed, but the segmentation is obscure. The terminal joint is produced into a long and slender flagellum about $3\frac{1}{2}$ times as long as the basal portion. The aesthetasc on the penultimate joint is fused with the terminal flagellum and extends a short distance beyond it. The antennae are reduced as compared with those of the female. No traces of mandible or first maxilla were seen. The second maxilla and maxillipede are of the same form as in the female, but weaker and more slender. The swimming-feet agree, with trifling differences, with those of the female. The fifth foot consists of a single seta. The abdomen is five-jointed. The furca is as in the female, the outer edge seta being short, transparent, ending in four serrations and situated ventrally. Giesbrecht, who had not seen the male, suggested, as did Scott himself, that it was doubtful whether Scott's specimens were mature or not.

The males in the present collection, which are evidently mature, confirm Scott's description in most points, but show that he has figured part of the fourth thoracic segment as belonging to the abdomen and has omitted the fifth feet.

Oncaea venusta, Philippi.

Giesbrecht, 1892.

Occurrence.—Inside the reef this species occurred on seven stations, usually single specimens of large size. On the deep-water stations outside it was taken on five stations.

Length : ♀, ·84–1·33 mm.

Remarks.—No clear division either in form or size could be made out between the larger and smaller sizes, except that the smaller, ·84–·91 mm., had a distinct reddish tinge on the mouth-parts and legs.

Oncaea mediterranea, Claus.

Giesbrecht, 1892.

Occurrence.—Only one specimen was found inside the reef, Stn. 14. On three stations outside the reef thirteen specimens in all were noted.

Length : ♀, ·98–1·25 mm.

Oncaea media, Giesbrecht.

Giesbrecht, 1892.

Occurrence.—Rather scarce. Occurred in small numbers on four stations outside the reef. One specimen was found at 3 mi. E., Stn. 14, and two in the samples examined from the serial stations, Stns. 62 and 68, at the same place.

Length : ♀, ·72–·78 mm.

Oncaea ornata, Giesbr.

Giesbrecht, 1891.

OCCURRENCE.—Two specimens, females, on Stn. 28, N. 600–0 m.
Length : ♀, ·85 mm.

Oncaea clevei, Fruchtl.

Fruchtl, 1923.

OCCURRENCE.—Allowing for its minute size it was very abundant on almost all the stations taken inside the reef and in the reef passages. It was also taken on the stations outside the reef, but in much smaller numbers except on Stn. 50, N. 150–0 m., where it was plentiful.

Length : ♀, ·63–·68 mm. ; ♂, ·53–·55 mm.

REMARKS.—F. Fruchtl (1923) has pointed out that this small species, which Cleve (1901), and doubtless others also, had taken for a small form of *O. conifera*, is in reality a distinct species, differing from others in the *conifera* group in having no terminal process on the exopodite of the fourth foot.

Oncaea conifera, Giesbr. (Text-figs. 25 and 26.)

Giesbrecht, 1892.

OCCURRENCE.—Form (*a*) : Stn. 19, C. 180–0 m., ♀ 4. Stn. 20, N. 250–0 m., ♀ 5, ♂ 5. Stn. 28, C. 600–0 m., ♀ 12. Stn. 45, C. 500–0 m., ♀ 4. Stn. 50, C. 150–0 m., ♀ 2.

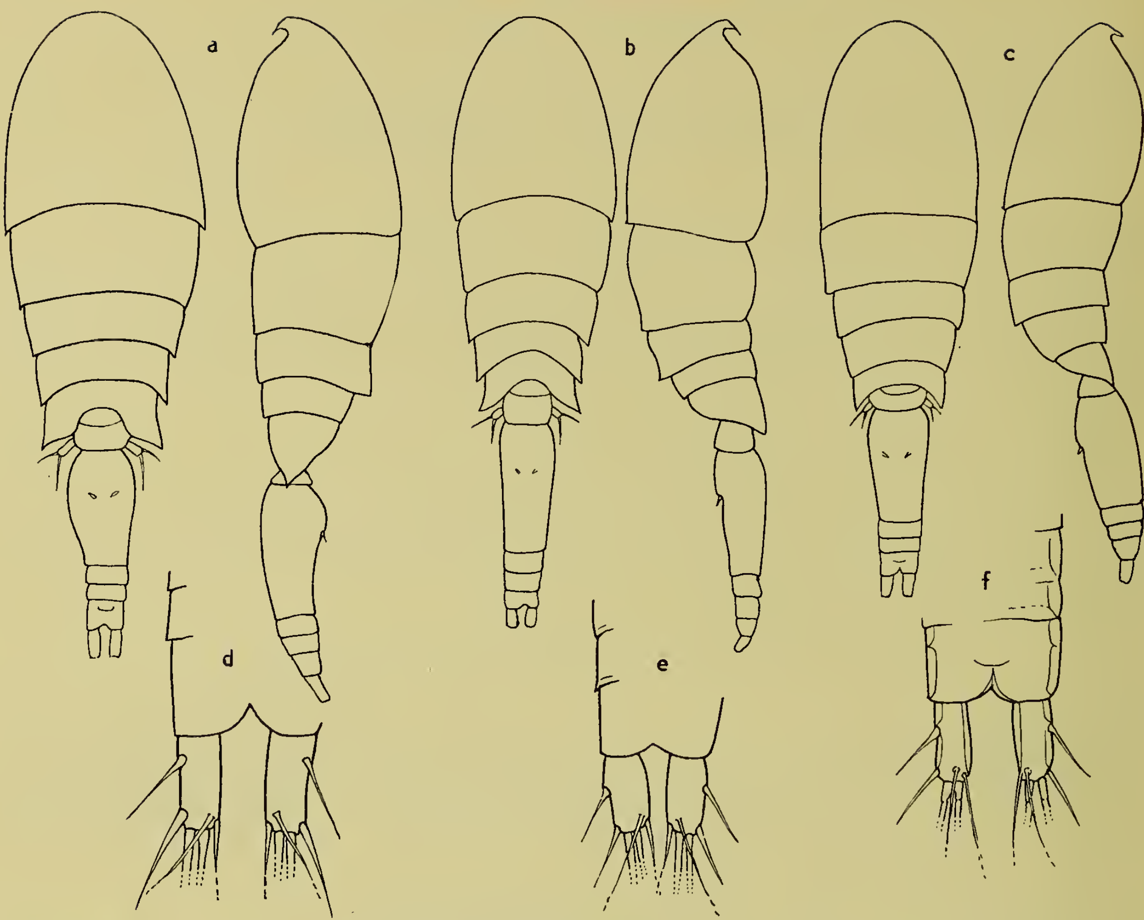
Form (*b*), var. *furcula* : Stn. 20, N. 250–0 m., ♀ 4, ♂ 1. Stn. 28, C. 600–0 m., ♀ 2, ♂ 2. Stn. 45, C. 500–0 m., ♀ 2, ♂ 2.

Form (*c*) : Stn. 28, C. 600–0 m., ♀ 1. Stn. 45, N. 500–0 m., ♀ 4.

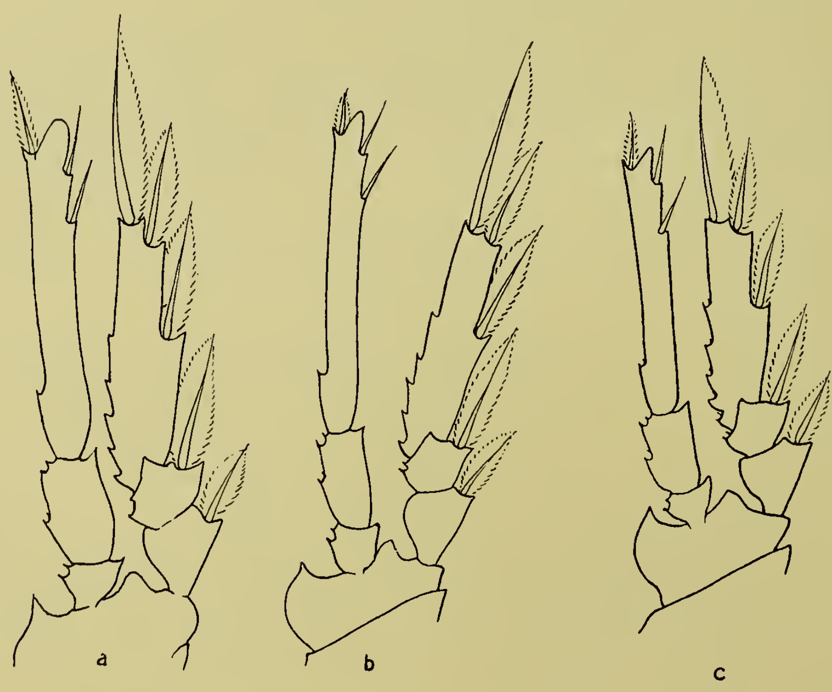
REMARKS.—The specimens in the collection fall into three clearly-marked groups, one of which appears to be entitled to varietal rank. The females may be distinguished as follows :

(*a*) Length 1·15–1·20 mm. (Text-fig. 25, *a*, *d* ; Text-fig. 26, *a*). Dorsal projection of second thoracic segment well marked. Abdomen, including fifth thoracic segment, included $1\frac{3}{4}$ times in the length of the anterior division. Lateral extensions of fourth thoracic segment parallel-sided in dorsal view. Greatest width of cephalothorax included $3\frac{1}{4}$ times in total length. Genital segment slightly swollen anteriorly and tapered, in lateral view, to nearly half its anterior width, longer than the rest of the abdomen by the length of the furca. Integument of the abdomen moderately thin. Fifth feet about two-thirds as long as furca. Furca equal to the anal segment, which is about equal to the two preceding segments.

(*b*) Length 1·08–1·14 mm. (Text-fig. 25, *b*, *e* ; Text-fig. 26, *b*). Distinctly more slender in general form than (*a*). Dorsal projection of second thoracic segment slight. Lateral extensions of fourth thoracic segment inclining outwards. Abdomen, including fifth thoracic segment, included $1\frac{2}{3}$ times in the length of the anterior division. Greatest width of cephalothorax included $3\frac{2}{3}$ times in total length. Genital segment slender, longer than the rest of the abdomen by more than the length of the furca and anal segment. Furca about equal in length to the anal segment, which is only slightly longer than either of the pre-anal segments. The furcal rami are oval rather than parallel-sided, often bent upwards dorsally, very fragile and often broken off. Swimming-feet more slender than in (*a*) or (*c*).



Text-fig. 25.—*Oncaea conifera.* Female, dorsal and lateral views : *a*, form *a* (length 1·2 mm.), × 75 ; *b*, form *b*, var. *furcula* (length 1·1 mm.), × 75 ; *c*, form *c* (length 1·0 mm.), × 75 ; *d*, furca (form *a*), × 247 ; *e*, furca (form *b*, var. *furcula*), × 247 ; *f*, furca (form *c*), × 247.



Text-fig. 26.—*Oncaea conifera.* Female : *a*, fourth foot (form *a*), × 247 ; *b*, fourth foot (form *b*, var. *furcula*), × 247 ; *c*, fourth foot (form *c*), × 247.

The male of this form may be distinguished by its more slender build and more acute cephalon in lateral view.

(*c*) Length ·96–1·02 mm. (Text-fig. 25, *c*, *f*: Text-fig. 26, *c*). Dorsal projection of second thoracic segment slight. General form as in (*a*), but stouter than (*b*). Lateral projections of fourth thoracic segment parallel-sided in dorsal view. Abdomen, including fifth thoracic segment, included $1\frac{2}{3}$ times in the anterior division. Greatest width of cephalothorax included about $3\frac{1}{2}$ times in total length. Genital segment stout and very slightly tapered in lateral view, longer than the rest of the abdomen by the furca and two-thirds of the anal segment. Fifth feet about half as long as the furca. Furca about equal to the anal segment, which is about three-fourths the length of the two preceding segments. Integument of abdomen very thick: pairs of lateral pores pierce it in the genital segment towards the distal end, in the second abdominal segment and in the anal segment. Sometimes these pores are unpaired, one or more of them being absent.

The characters of (*b*), which may be designated as var. *furcula*, are the most clearly marked, and show more decided differences than either (*a*) or (*c*) from *O. conifera* as described by Giesbrecht (1892).

Text-figs. 25 and 26 show the dorsal and lateral views, the furca and the fourth foot of each of these forms.

Conaea rapax, Giesbr.

Giesbrecht, 1892.

Occurrence.—Several specimens, both male and female, on one station, Stn. 28, N. 600–0 m., outside the reef.

Length: ♀, ·96 mm.; ♂, ·87 mm.

Lubbockia aculeata, Giesbr.

Giesbrecht, 1892.

Occurrence.—A single female on Stn. 45, N. 500–0 m.

Length: ♀, 2·10 mm.

Lubbockia squillimana, Claus.

Giesbrecht, 1892.

Occurrence.—Taken in small numbers on all the stations outside the reef, in hauls ranging in depth between 150–0 m. and 600–0 m. Only females were found.

Pachysoma tuberosum, Giesbr.

Giesbrecht, 1892.

Occurrence.—One specimen, a female, on Stn. 19, N. 180–0 m.

Length: ♀, 1·95 mm.

Sapphirina metallina, Dana.

Lehnhofer, 1929.

Occurrence.—Only taken outside the reef, Stns. 19, 20, 28 and 50, in all twelve males and three females.

Length: ♀, 1·92–2·04 mm.; ♂, 1·92–1·98 mm.

Sapphirina angusta, Dana.

Lehnhofer, 1929.

Occurrence.—Taken twice inside the reef, Stn. 38, one female, and Stn. 57, five males, and twice over deep water, Stns. 19 and 50, one male on each.

Length : ♂, 3·36–4·92 mm.

Sapphirina bicuspidata, Giesbr.

Lehnhofer, 1929.

Occurrence.—One male taken over deep water on Stn. 20.

Length : ♂, 2·9 mm.

Sapphirina scarlata, Giesbr.

Lehnhofer, 1929.

Occurrence.—One male taken over deep water on Stn. 19.

Length : ♂, 3·6 mm. Proportional length of antennule joints 1 + 2 : 3 + 4 + 5 = 1·77 : 1·00.

Remarks.—The total length is intermediate between the lengths given by Lehnhofer (1929) for *S. nigromaculata* and *S. scarlata*, but is within the range of sizes given by Giesbrecht for *S. scarlata*. The proportional lengths of the antennule joints agree with *S. scarlata*. The spine on the second joint of the antennule is slightly larger than is figured by Lehnhofer.

Sapphirina nigromaculata, Claus.

Lehnhofer, 1929.

Occurrence.—Two males taken over deep water on Stns. 49 and 50.

Length : ♂, 2·05–2·16 mm.

Sapphirina stellata, Giesbr.

Lehnhofer, 1929.

Occurrence.—Taken twice inside the reef, Stns. 14 and 38, and once outside, Stn. 19, three males in all.

Length : ♂, 1·75–2·10 mm.

Sapphirina aurinitens, Giesbr.

Lehnhofer, 1929.

Occurrence.—Once inside the reef, Stn. 24, one male, and once outside, Stn. 20, one female.

Length : ♀, 1·60 mm., with narrow furca measuring ·16 × ·096 mm. ; ♂, 2·04 mm. with furca of typical form, ·21 × ·17 mm.

Sapphirina opalina, Dana.

Lehnhofer, 1929.

Occurrence.—Two specimens inside the reef, Stn. 35, ♀ 1, and Stn. 38, ♂ 1. Two females, one of them immature on Stn. 45. outside the reef.

Length : ♀, 3·30 mm. ; ♂, 3·9 mm.

Sapphirina iris, Dana.

Lehnhofer, 1929.

Occurrence.—Taken on two successive stations inside the reef, Stn. 40, S., ♂ 1, N., ♂ 1, and Stn. 41. N., ♀ 1, and on one station outside, Stn. 50, ♀ 1.

Length : ♀, 5·78–6·00 mm. ; ♂, 5·3 mm. All specimens were of the *longifurca* type.

Sapphirina ovatolanceolata.

Giesbrecht, 1892.

Occurrence.—The male of this species is the commonest *Sapphirina* in the collection. It was taken on six stations inside the reef, Stn. 23, N., ♂ 2 ; Stn. 35, S., ♂ 5 ; N., ♂ 1 ; Stn. 52. S., ♂ 1 ; Stn. 57. S., ♂ 5 ; Stn. 58, S., ♂ 1 ; Stn. 60, S., ♂ 8 ; N., ♂ 1 ; and on three stations outside, Stn. 19. 28 and 50, 6 specimens in all. Only one female was found, on Stn. 45, outside the reef.

Length : ♀, 2·64 mm. ; ♂, 2·52–3·24 mm.

Remarks.—Lehnhofer (1929). following Steuer. has united this species with *S. gemma*, having found a continuous series, through intermediate forms, from one to the other. The female agreed with Giesbrecht's figure of *S. ovatolanceolata*, the cephalon being broader than the first thoracic segment. The cephalothorax, broad anteriorly and tapering to a narrow fourth thoracic segment, which is only half as wide again as the fifth segment, is a noticeable character.

Corissa, n. gen.

In many respects this genus, represented by a single specimen, comes very near to *Vettoria*, Wilson (*Corina*, Giesbrecht). The points which appear to be of generic importance in distinguishing the specimen from *Vettoria granulosa* are the 3-jointed abdomen, instead of 2-jointed, the form of the furcal rami, narrow and elongate, and the position of the inner edge seta of the furca on its inner margin, a dorsal position being more usual in the Corycaeidae. The mandible and second maxilla approach more nearly to those found in *Sapphirina* than to those of *Vettoria* as described by Giesbrecht, but Giesbrecht's description based on one specimen of ·68 mm. in length, is, he admits, defective.

The swimming-feet agree in the arrangement of spines and setae with those of *Vettoria granulosa* except that in the second and third feet the third joint of the endopodite has an additional outer edge seta. The form of the 2-jointed endopodite of the fourth foot is identical in the two species. The presence of a single seta representing the fifth foot, instead of three, as in *Vettoria*, is a further point of difference.

Corissa parva, n. sp. (Text-fig. 27.)

Occurrence.—One female on Stn. 20 outside the reef, Nansen net, 250–0 m.

Description.—Female (Text-fig. 27, *a*, *b*), length ·87 mm. Anterior division ·60 mm., posterior ·27 mm. Cephalon separated from thorax. Fifth thoracic segment much narrower than the fourth. Abdomen (Text-fig. 27, *c*) 3-jointed, the proportional length of the abdominal segments and furca being 25 : 5 : 8 : 28. Genital openings dorso-lateral with a short seta posterior to each. Genital segment broadened in its anterior three-fifths, the swollen broadened portion being sharply marked off from the rest. Anal segment wider than the preceding segment. Furca long and narrow, broadest at its anterior end and tapered to about half its greatest width, with one inner edge, one outer edge and three terminal setae, the innermost being longest and about two-thirds of the total length of the furca. Cephalon with a small lateral lenticular swelling near its posterior margin on either side and two contiguous cuticular lenses occupying the whole frontal width.

Antennules (Text-fig. 27, *d*) 5-jointed ; proportional length of joints 19 : 36 : 30 : 14 : 24 ; segmentation between fourth and fifth joints imperfect.

Antennae (Text-fig. 27, *e*) long and slender, 4-jointed with terminal hook, first joint with slender distal spine, second joint with spine at the proximal two-fifths, third joint with two short setae, fourth joint ending in two setae and a strong claw ; proportional length of joints and claw 36 : 80 : 10 : 60 : 20.

Mandible (Text-fig. 27, *f*) a broad, scythe-shaped claw, setose on its anterior margin.

First maxilla (Text-fig. 27, *f*) a short clavate process, with three spines. Second maxilla (Text-fig. 27, *g*) with a broad basal and a curved terminal claw, setose on the outer margin of the curve.

Maxillipede with a short stout basal joint, a slightly longer and thicker second joint and a stout terminal spine, or tapered third joint, with a thickened base and a basal seta.

Swimming-feet slender, with 3-jointed exopodites and endopodites, except for a 2-jointed endopodite on the fourth foot, the arrangement of spines and setae being shown in Text-fig. 27, *i–l*. The outer edge spines of the exopodites are lancet-shaped, with very tenuous denticulate margins. The terminal spines of the exopodites have finely denticulated outer edges. Fifth foot of a single seta on each side of fifth thoracic segment.

Copilia vitrea (Haeckel).

Lehnhofer, 1926.

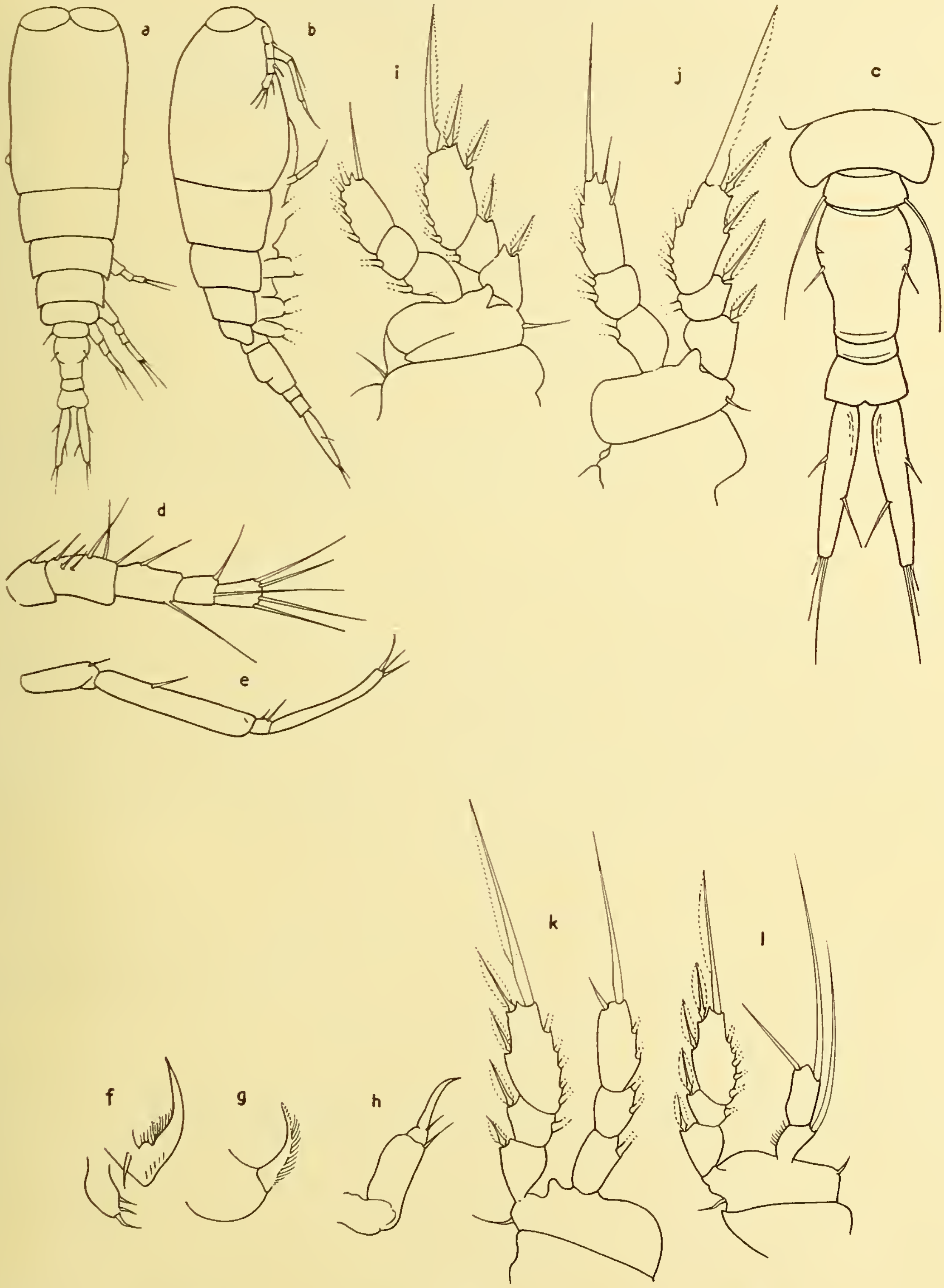
Occurrence.—On two stations over deep water outside the reef : Stn. 20, ♂ 1 ; Stn. 28, ♀ 2.

Copilia mirabilis, Dana.

Lehnhofer, 1926.

Occurrence.—The commonest species of *Copilia*. Found in small numbers in almost every townetting taken outside the reef, as well as on one station, Stn. 43, off Cape Bedford and on two at 3 mi. W., Stns. 29 and 51.

Remarks.—Males both of the typical form and of the form *platyonyx* occurred, sometimes in the same townetting.



TEXT-FIG. 27.—*Corissa parva*, n. sp. Female : *a*, dorsal view, × 87 ; *b*, lateral view, × 87 ; *c*, abdomen, × 237 ; *d*, antennule ; *e*, antenna ; *f*, mandible and maxilla ; *g*, second maxilla ; *h*, maxillipede ; *i*, first foot ; *j*, second foot ; *k*, third foot ; *l*, fourth foot (*d–l*, × 320).

Copilia quadrata, Dana.

Lehnhofer, 1926.

Occurrence.—Next to *C. mirabilis* this was the commonest species of the genus. It occurred on all the stations outside the reef, but only from one to three specimens on each; and also on one station in the reef passages, Stn. 29.

Copilia lata, Giesbr.

Lehnhofer, 1926.

Occurrence.—On two stations outside the reef: Stn. 19, ♂ 1; Stn. 20, ♂ 2.

Corycaeus speciosus, Dana.

Dahl, 1912.

Occurrence.—From one to three specimens were found on eight of the fourteen stations at 3 mi. E. from which small specimens were available. It occurred on five other stations inside the reef and in moderate numbers on the stations outside the reef.

Corycaeus crassiusculus, Dana. (Text-fig. 28.)

Corycaeus crassiusculus, Dahl, 1912.
C. danae, Giesbrecht, 1892.

Occurrence.—On four stations outside the reef: Stn. 19, ♀ 8, ♂ 3; Stn. 20, ♀ 1; Stn. 28, ♀ 4; Stn. 48, ♀ 1. One specimen, ♀, in the serial townets at Stn. 62.

Length: ♀, 1·68–1·70 mm.; ♂, 1·58 mm.

Remarks.—The female is figured (Text-fig. 28, *c*, *d*) for comparison with that of *C. vitreus*. In the specimen figured the abdomen is straight, but in several others it was flexed ventrally, as shown in M. Dahl's figure (1912, pl. iii, fig. 2).

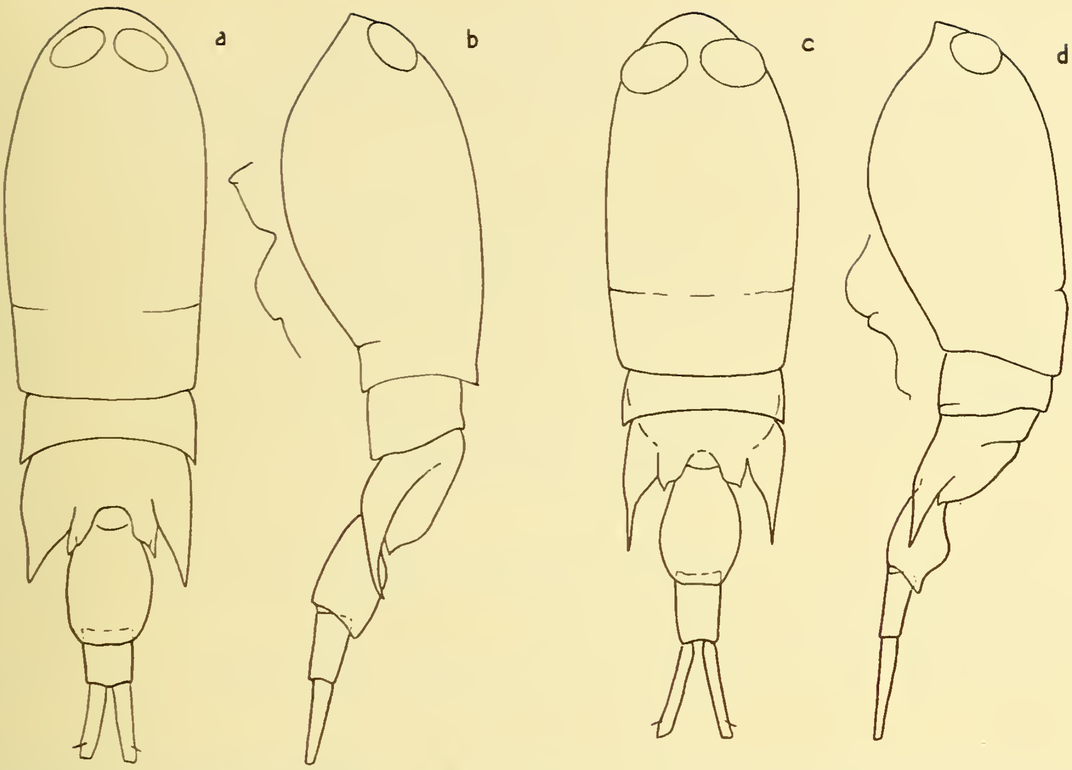
Corycaeus vitreus, Dana. (Text-fig. 28.)

Dahl, 1912.

Occurrence.—Once inside the reef, Stn. 3, ♂ 1. Outside the reef on two stations: Stn. 19, 1 m. C. 180–0 m., ♂ 4; S. 180–0 m., ♂ 1, ♀ 1. Stn. 28, N. 600–0 m., ♂ 1.

Length: ♀, 1·68 mm.; ♂, 1·62–1·70 mm.

Remarks.—Dana's (1852, 1855) original description and figure of the male of this species being inadequate, I have accepted without question the redescription and figures given by M. Dahl (1912) of the specimen from the Plankton Expedition. The characters which are given to separate it from the males of *C. clausi* and *C. crassiusculus* are the short cephalon, very broad in front and tapering posteriorly, the short anal segment and the fine transparent edge to the longest furcal seta. In company with males there was taken on one station a single specimen which appears to be the undescribed female of this species (Text-fig. 28, *a*, *b*). In form it is more robust than *C. crassiusculus*. The abdomen is shorter and broader in dorsal view, though scarcely differing when seen from the side. The furcal rami are noticeably broader and more tapered. There is a membranous edge to the longest furcal seta, but it is narrow and tenuous and difficult to make out, and is



TEXT-FIG. 28.—*Corycaeus vitreus.* × 58. Female : *a*, dorsal view ; *b*, lateral view, × 58. *Corycaeus crassiusculus.* Female : *c*, dorsal view, × 58 ; *d*, lateral view, × 58.

equally present in the furcal seta of *C. crassiusculus.* This specimen appears to be identical with the females which I formerly recorded (1929) with some hesitation from off New Zealand as *C. crassiusculus.*

Corycaeus robustus, Giesbr.

Dahl, 1912.

OCCURRENCE.—One female on Stn. 20, outside the reef.
Length : ♀, 2·18 mm.

Corycaeus typicus, Kröyer.

Dahl, 1912.

OCCURRENCE.—On four stations outside the reef : Stn. 19, C. 180–0 m., ♀ 11 ; N. 180–0 m., ♀ 2. Stn. 20, N. 250–0 m., ♀ 16, ♂ 10. Stn. 28, N. 580–0 m., ♀ 3, ♂ 1. Stn. 50, N. 150–0 m., ♀ 2.
Length : ♀, 1·57–1·59 mm. ; ♂, 1·41–1·49 mm.

Corycaeus flaccus, Giesbr.

Dahl, 1912.

OCCURRENCE.—On two stations outside the reef : Stn. 19, N. 180–0 m., ♀ 17 ; Stn. 28, N. 580–0 m., ♀ 2.
Length : ♀, 1·66–1·75 mm.

Corycaeus limbatus, Brady.

Dahl, 1912.

Occurrence.—On four stations outside the reef: Stn. 19, ♀ 2; Stn. 20, ♀ 1; Stn. 28, ♀ 2; Stn. 45, ♀ 1.

Length: ♀, 1·32–1·45 mm.

Corycaeus longistylis, Dana.

Dahl, 1912.

Occurrence.—On one station outside the reef: Stn. 19, S. 180–0 m., ♀ 1; 1 m. C. 180–0 m., ♂ 2.

Length: ♀, 2·60 mm.; ♂, 2·16–2·24 mm.

Corycaeus lautus, Dana.

Dahl, 1912.

Occurrence.—On one station outside the reef: Stn. 19, S. 180–0 m., ♀ 2, ♂ 1; 1 m. C. 180–0 m., ♀ 6, ♂ 8.

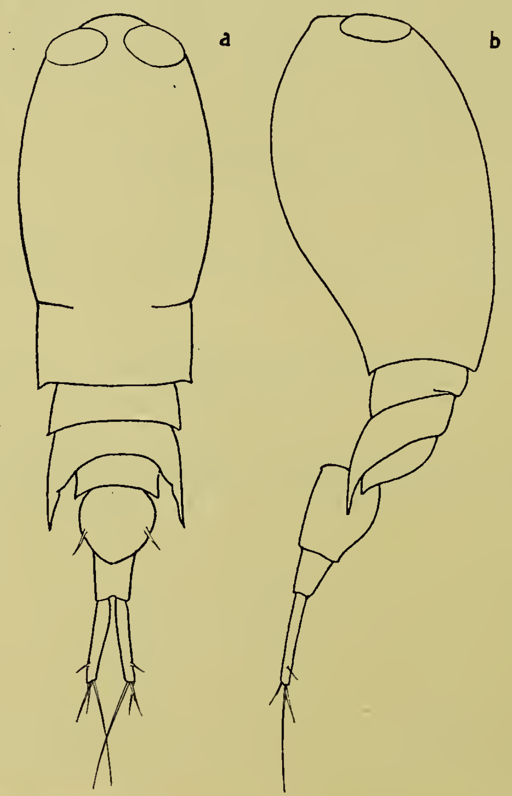
Length: ♀, 2·84 mm.; ♂, 2·16–2·22 mm.

Corycaeus furcifer, Claus.

Dahl, 1912.

Occurrence.—On four stations outside the reef: Stn. 19, N. 180–0 m., ♂ 1; Stn. 20, N. 250–0 m., ♀ 1; Stn. 28, N. 600–0 m., ♀ 3; Stn. 45, N. 600–0 m., ♀ 2, ♂ 2.

Length: ♀, 1·70–1·74 mm.; ♂, 1·23–1·27 mm.



Text-fig. 29.—*Corycaeus minimus.* Female: *a*, dorsal view, × 120; *b*, lateral view, × 120.

Corycaeus minimus, F. Dahl. (Text-fig. 29.)

Dahl, 1912.

Occurrence.—Two females were taken on Stns. 20 and 28, outside the reef.

Length : ♀, ·75–·78 mm.

Remarks.—These two specimens (Text-fig. 29, *a*, *b*) come very near to Dahl's description of *C. minimus indicus*, with which they agree in the following points : The furca is slightly divergent ; the third thoracic segment is longer than in the typical form ; there is a minute rudimentary hook on the ventral side of the genital segment ; the anal segment is as wide at the base as it is long and is slightly tapered distally. They differ in the slightly longer furca, twice as long as the anal segment and 7½ to 8 times as long as wide. As compared with M. Dahl's figure, the genital segment is broader and more globular in dorsal view. Klevenhusen (1933) has described, from the Atlantic, a form of *C. minimus* with a ventral hook on the genital segment.

Corycaeus lubbocki, Giesbr.

Dahl, 1912.

Occurrence.—Taken in moderate numbers on almost all the stations inside the reef from which small specimens were available. A few were taken outside the reef on Stns. 19, 45 and 50.

Length : ♀, ·98–1·05 mm.

Corycaeus erythraeus, Cleve.

Corycaeus dubius, Farran, 1911 ; Dahl, 1912.

Occurrence.—Inside the reef this species was rather more numerous than *C. lubbocki*. It occurred on the same stations and also in some additional gatherings. Outside the reef it was taken on Stns. 19, 20, 45 and 50, in small numbers on the first three, but in comparative abundance on Stn. 50.

Length : ♀, ·96–1·05 mm. ; ♂, ·84–·91 mm.

Remarks.—Gurney (1927) has described and referred to *C. erythraeus*, Cleve, a species which occurred in considerable numbers in the Suez Canal and at Suez. The correctness of his identification can hardly be doubted, since *C. erythraeus* was first described from the Red Sea. It is evident from Gurney's description that there is no essential difference between *C. erythraeus* and *C. dubius*.

Corycaeus asiaticus, F. Dahl.

Corycaeus asiaticus, Dahl, 1912.
C. murrayi, Farran, 1911.

Occurrence.—As in the case of *C. lubbocki* and *C. erythraeus*, this species occurred on all the stations inside the reef from which small specimens were available, but it was less than half as common as *C. erythraeus*. Outside the reef it was taken in small numbers on Stns. 19 and 45, and was plentiful on Stn. 50.

Length : ♀, 1·26–1·38 mm. ; ♂, 1·16–1·26 mm.

Remarks.—The wings of the fourth thoracic segment in the female of these specimens ended in an acute point and no seta could be seen on the genital segment.

Corycaeus andrewsi, Farran.

Dahl, 1912.

Occurrence.—Two females were taken in a surface haul on Stn. 4 inside the reef.

Length : ♀, ·81–·88 mm.

Corycaeus subtilis, M. Dahl.

Dahl, 1912.

Occurrence.—On three stations inside the reef, Stn. 55 ; ♀ 1, Stn. 62, ♀ 2 ; Stn. 68, ♀ 6 ; and on two over deep water, Stn. 19, ♀ 1 ; Stn. 50, ♀ 5. Taking into consideration its very small size it is evidently not an uncommon species.

Length : ♀, ·72–·82 mm.

Corycaeus agilis, Dana.

Dahl, 1912.

Occurrence.—On five stations inside the reef and two, Stns. 20 and 50, over deep water. Scarce except on Stn. 50, on which 22 females and 2 males were observed.

Length : ♀, ·95–·97 mm. ; ♂, ·68 mm.

Corycaeus pumilus, M. Dahl.

Dahl, 1912.

Occurrence.—Taken only over deep water, on Stns. 45 and 50, 13 ♀ and 2 ♂ in all.

Length : ♀, ·66–·76 mm. ; ♂, ·70 mm.

Remarks.—These specimens differed in some respects from the type described by M. Dahl (1912), but came nearer to it than to *C. medius*, Gurney, from the Suez Canal. The greater length of the anterior segment, cephalon and first thoracic segment, equal to three-fifths of the total length, agrees with *C. pumilus*, as does the short abdomen, 2½ times in the anterior division of the body. A difference from *C. pumilus* is the great length of the inner furcal seta, which is more than 4 times as long as the furca, 3 times as long as the second seta and 9 times as long as the third, which is short and spiniform and about half as long as the furcal rami.

In the form of the abdomen and terminal setae it agrees fairly well with *C. medius*. As *C. pumilus* was only described from three specimens, it seems possible that Dana's description of the longest furcal seta as not twice as long as the furca may have been based on an imperfect specimen. Out of the nine females in the collection measured only two had the furcal setae intact.

Corycaeus catus, F. Dahl.

Dahl, 1912.

Occurrence.—Found in moderate numbers in most of the townettings inside the reef from which small specimens were available. One or two specimens were also found in eight out of the remaining reef samples. It was taken on four stations over deep water —Stns. 19, 28, 45 and 50—being common on two of them—Stns. 45 and 50.

Length : ♀, ·92–1·01 mm. ; ♂, ·78–·87 mm.

Corycaeus pacificus, F. Dahl.

Dahl, 1912.

Occurrence.—A very scarce species, taken only in two of the stations over deep water, Stns. 19 and 28, four females.

Length : ♀, 1·04–1·08 mm.

Remarks.—Though this species comes very near in size and general form to the preceding *C. catus*, it can be separated under a sorting lens by its slightly larger size and longer furca. Under a microscope can be observed the additional characters of blunted short points to the wings of the fourth thoracic segment, the shorter and broader third thoracic segment, and the very small size of the seta on the genital segment.

Corycella gibbula (Giesbr.).

Corycaeus gibbulus, Dahl, 1912.

Occurrence.—Taken both inside the reef and over deep water. It occurred in eight out of the fourteen stations on the reef from which small specimens were available, and on five out of six stations over deep water.

Length : ♀, ·88–·98 mm.

Corycella carinata (Giesbr.).

Corycaeus carinatus, Dahl, 1912.

Occurrence.—Only taken on the stations over deep water, where it occurred on five of the six stations outside the reef.

Length : ♀, ·80–·85 mm.

Remarks.—All the specimens agreed with the form which I have figured from Christmas Island (Farran, 1911).

Corycella concinna, Dana.

Corycaeus concinnus, Dahl, 1912.

Occurrence.—Found on six of the fourteen stations inside the reef from which small specimens were available, and on five of the six hauls over deep water. Slightly more numerous than *C. gibbula* over the reef, but scarcer outside it.

Length : ♀, ·88 mm.

Corycella curta, Farran.

Corycaeus curtus, Dahl, 1912.

Occurrence.—One specimen, a female, was taken outside the reef on Stn. 28.

Length : ♀, ·76 mm.

Saphirella tropica, Wolfenden. (Text-fig. 30.)

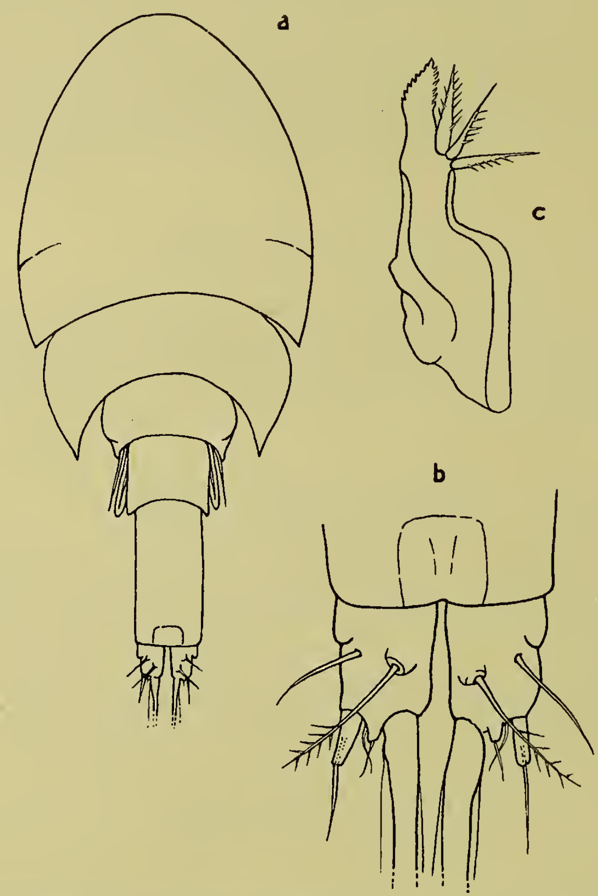
Wolfenden, 1905.

Occurence.—One specimen in the lowest of the serial hauls on Stn. 65 at 3 mi. E., where the depth is 32 m.

Length : 1·12 mm.

Remarks.—This specimen, the carapace of which is finely pitted, agrees in most points with the figures which Wolfenden (1906) has given of *S. tropica* from the Maldive Archipelago, and shows distinct differences from *S. indica*, Sewell.

Wolfenden's fig. 16 on plate xcix is duplicated. The two figures closely resemble the second maxilla and the maxillipede of the Barrier Reef specimen, though only one is represented in the explanation of plates, under the designation of "Mandible Palp ?"



Text-fig. 30.—*Saphirella tropica.* *a*, dorsal view, × 84; *b*, furca, dorsal view, × 277; *c*, mandible, × 277.

Wolfenden's fig. 17, designated "Maxilla and ? anterior footjaw", appears to represent the mandible and part of the first maxilla, but does not correspond very well with my specimen. The figure of the mandible here given (Text-fig. 30, *c*) is taken from a specimen, found in a collection of Copepoda from Christmas Island in the Indian Ocean, which was identical with the Barrier Reef specimen.

Sewell (1924) has given a critical account of previous records of the genus, and accepts the reasonable view of Canu (1888) that it represents the first copepodite stage of a parasitic form. His opinion that the mandible is absent and that the appendage usually described as the mandible is part of the maxilla is more open to question.

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BY

W. M. TATTERSALL, D.Sc.

Professor of Zoology, University College, Cardiff

WITH FOURTEEN TEXT-FIGURES

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CONTENTS.*

MYSIDACEA.

INTRODUCTION.

THE collection of Mysidacea made by the Barrier Reef Expedition comprises twenty-three species. They were all collected in townets used during investigations on the plankton of the Barrier Reef region. No dredging operations were undertaken, and no special attention was paid to the bottom fauna of the area. At one station (Stn. 29) the bottom stramin net actually touched the bottom and collected six species of bottom-living Mysids. The remaining seventeen species are planktonic forms. I have elsewhere analysed the plankton catches as far as the Mysidacea are concerned. A summary of these results may appropriately be given here.

* The occurrence and seasonal distribution of the Mysidacea and Euphausiacea are discussed in a separate report (see Vol. II, No. 8).

The plankton hauls were mainly made in the daylight, but a few night hauls are available for comparison. Mysids form a very insignificant part of the daylight plankton. In no case did the total number of mysids in any haul exceed ·4% of the total animals caught in the nets. Mysids were absent from the daytime plankton from October to April, and were most abundant in August and May.

The planktonic mysids from the daylight plankton belong mainly to two species, *Anchialina typica* and *Promysis orientalis.* Six other species occurred in daylight hauls, but only in single specimens very occasionally. These six species were :

Siriella thompsoni.	*Anchialina grossa.*
,, *vulgaris.*	*Doxomysis littoralis.*
Hemisiriella parva.	*Anisomysis laticauda.*

An analysis of the vertical distribution of the two common planktonic species, *Anchialina typica* and *Promysis orientalis,* shows that they exhibit diurnal migrations, rising to the upper waters and even to the surface by night and descending to the deeper waters by daytime.

An examination of the plankton hauls made during hours of darkness presents a very different picture of the mysid population. No fewer than seventeen species of mysids occurred in night hauls. Some of these, notably *Hemisiriella pulchra, Pseudanchialina pusilla, Doxomysis littoralis* and *Siriella dubia,* occurred in some considerable numbers. These results suggest that most of the mysids of the Barrier Reef region are bottom-living by day and become planktonic by night only.

With regard to the geographical distribution of the Barrier Reef mysids sixteen species were captured by the " Siboga " Expedition in the waters of the Dutch East Indies, and of these eight are also known from the coast of India. The collection, which may be taken to represent the littoral fauna of the Barrier Reef, demonstrates that this fauna is part of a more or less uniform, shallow-water tropical fauna extending from the Indian Ocean to the Western Pacific, and is probably even more generally distributed in the Pacific area.

Two species, *Siriella thompsoni* and *Anchialina typica,* have a distribution which extends outside this area. The former is an oceanic species of world-wide distribution in tropical waters, and apparently invades the shallow water of the lagoon area of the reef under certain exceptional physical conditions. The latter species also is widespread in tropical and subtropical waters of both Pacific and Atlantic oceans. It is a regular planktonic species in the Barrier Reef area from May to October, and there is a suggestion that it migrates inshore during this season of the year for breeding purposes, moving out to deeper water again in the non-breeding season. The same is probably true for *Promysis orientalis* also.

The collection contains four species described as new to science : *Pseudomysidetes russelli, Metamblyops stephensoni, Erythrops yongei* and *Anisomysis incisa.* One other species is probably new, but the material is too scanty to allow of adequate description.

SYSTEMATIC ACCOUNT.

Order MYSIDACEA.

Sub-Order MYSIDA.

Family Mysidae.

Sub-Family Siriellinae.

Genus *Siriella*, Dana.

Siriella thompsoni (H. Milne-Edwards).

S. thompsoni, Hansen, 1910.

Occurrence.—Stn. 16, 3 mi. E. of Low Isles, 3.xi.28, coarse townet at 8 m., 1 immature male.

Stn. 27, 3 mi. E. of Low Isles, 21.xi.28, 1 m. stramin net, 1 immature male.

Low Isles Lagoon, 16.xi.28, small coarse net at night, 1 immature.

Remarks.—An oceanic species which apparently finds its way into the lagoon under certain conditions. Its occurrence in the lagoon coincided with that of certain species of oceanic Euphausians, and no specimens were found in any of the hauls taken later than November.

Siriella nodosa, Hansen.

S. nodosa, Hansen, 1910.
S. nodosa, Colosi, 1918 and 1920.

Occurrence.—Taken on four occasions at the Low Isles anchorage, in night townettings made with the small coarse townet.

Remarks.—No specimen occurred in hauls made in daylight at any time of the year. The specimens agree very closely with Hansen's description and figures. In immature specimens only the post-cervical protuberance on the dorsal surface of the carapace is present—the pre-cervical one, however, appearing in all adult specimens.

Distribution.—East Indies (Hansen, 1910); Torres Straits (Colosi, 1918 and 1920).

Siriella vulgaris, Hansen.

S. vulgaris, Hansen, 1910.
S. vulgaris, Tattersall, 1922.
S. vulgaris, Colosi, 1924.
S. vulgaris, Tattersall, 1928.

Occurrence.—Stn. 2, 3 mi. E. of Low Isles: 30.vii.28, 1 m. stramin net, 1, immature.

Stn. 63, 24.vi.29, coarse net, 1, immature.

Low Isles Anchorage and Low Isles Flat: Taken on six occasions in night townettings, 20 specimens in all, including adult males and females and immature specimens.

Remarks.—It is significant that this species occurred mainly in night townettings.

Distribution.—East Indies (Hansen, 1910); India (Tattersall, 1922); Arabian Sea (Colosi, 1924); Queensland (Tattersall, 1928).

Siriella inornata, Hansen.

S. inornata, Hansen, 1910.
S. inornata, Tattersall, 1928.

Occurrence.—Taken on six occasions in night townettings at the Low Isles Anchorage and over the Low Isles Flat.

Remarks.—Twenty-three specimens occurred in the collections in all. Adult males and females occurred in May and June, and measured 12 mm. The females were carrying eggs in June. The specimens caught in October and November were immature, measuring only 5–6 mm. It is interesting that the species only occurred in night townettings.

Distribution.—Known only from the East Indies (Hansen, 1910) and Queensland (Tattersall, 1928).

Siriella anomala, H. J. Hansen.

S. anomala, Hansen, 1910.

Occurrence.—Low Isles Anchorage, 28.vi.29, small coarse net at night, 1 male, 10 mm.

Remarks.—The specimen agrees well with Hansen's description.

Distribution.—Known previously only from the Siboga collections from the East Indies.

Siriella dubia, Hansen. (Text-fig. 1.)

S. dubia, Hansen, 1910.
S. dubia, Tattersall, 1922.

Occurrence.—Stn. 65, 3 mi. E. of Low Isles, 10.vii.29. Coarse silk townet: Surface, 12 specimens; 3–7 m., 3 specimens; 8 m., 9 specimens; 12·5 m., 1 specimen.

Remarks.—These specimens confirm my earlier observations (1922) that in this species there are three small equal spines at the apex of the telson between the inner pair of large spines, in addition to the usual pair of plumose setae. *S. dubia* thus conforms to the usual type of telson found in other species of the genus, and Hansen's type-specimen must be regarded as abnormal in this particular. The species is, however, quite peculiar in having the proximal joint of the outer uropods armed with *both* spines and setae on its outer margin. The serrations noted by Hansen on this margin represent the bases of broken-off setae and not spines. Several of the specimens in this collection have the setae intact, and thus confirm my previous observations on this point (1922).

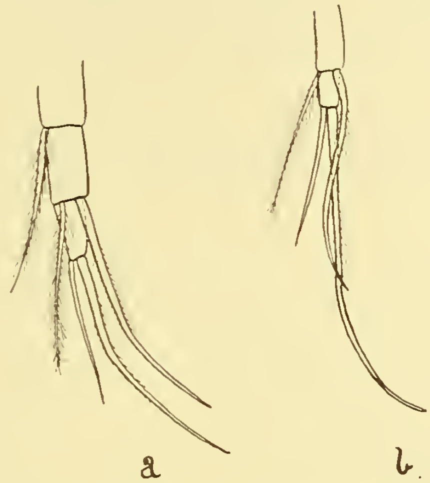
Both the third and fourth pleopods of the male have the endopod modified at the extremity. No other species of the genus to my knowledge has both these pleopods modified. I give herewith (Text-fig. 1) figures of the extremities of the endopod of both third and fourth pleopods of the male to illustrate this feature, and also to correct my previous account of the fourth pleopod of the male (1922).

The terminal joint of the endopod of both pleopods bears two modified setae, one very much longer than the other.

The penultimate joint bears one modified seta, slightly curved in the third pleopod, and more curved in the fourth. The long modified setae of the third pleopod are more or less equal in length, but on the fourth pleopod that of the terminal joint is considerably

longer than that of the penultimate joint. The long stout setae are apparently finely feathered, the shorter terminal setae being simple.

DISTRIBUTION.—East Indies (Hansen, 1910); India (Tattersall, 1922).



TEXT-FIG. 1.—*Siriella dubia*, Hansen. *a*, Terminal portion of the endopod of the third pleopod of the male; *b*, terminal portion of the endopod of the fourth pleopod of the male. Both × 112.

Genus *Hemisiriella*, Hansen.

Hemisiriella pulchra, Hansen.

H. pulchra, Hansen, 1910.

OCCURRENCE.—Stn. 21, 3 mi. E. of Low Isles, 22.x.28, 1 m. stramin net at night, 1 female and 2 immature specimens.

Stn. 65, 3 mi. E. of Low Isles, 10.vii.29, series of townettings at night, abundant, especially in the upper layers of water.

DISTRIBUTION.—Hitherto only known from Hansen's original locality in the East Indies.

Hemisiriella parva, Hansen.

H. parva, Hansen, 1910.
H. parva, Colosi, 1918 and 1920.
H. parva, Zimmer, 1918.
H. parva, Tattersall, 1922.

OCCURRENCE.—Stn. 1, 3 mi. E. of Low Isles, 27.vii.28, coarse townet, 1 immature female.

DISTRIBUTION.—East Indies (Hansen, 1910); Indian Ocean (Colosi, 1918 and 1920); Java (Zimmer, 1918); Andaman Islands (Tattersall, 1922).

Sub-Family RHOPALOPHTHALMINAE.

Genus *Rhopalophthalmus*, Illig.

Rhopalophthalmus egregius, Hansen.

R. egregius, Hansen, 1910.
R. egregius, Nakazawa, 1910.
R. egregius, Tattersall, 1915, 1921, 1922.
R. egregius, Colosi, 1918, 1920.

Occurrence.—Stn. 29, outside Trinity Opening, 24.xi.28, bottom stramin net, 1 very young specimen.

Remarks.—The single specimen is very small and immature, but appears to belong to this species. The only difference of note between the specimen and Hansen's description and figures is that the apex of the rostrum is slightly emarginate. This is possibly a character of immaturity.

Distribution.—Widely distributed in shallow waters of the Pacific Ocean from India to Japan, including a record by Colosi from between New Caledonia and New Zealand.

Sub-Family Gastrosaccinae.

Genus *Anchialina*, Norman.

Anchialina typica (Kröyer).

A. typica, Hansen, 1910, 1912.
A. typica, Colosi, 1918, 1920.
A. typica, Tattersall, 1922, 1923, 1926.

Occurrence.—One of the most characteristic species of the Barrier Reef Lagoon. It occurred in small numbers at the weekly plankton station, 3 mi. E. of Low Isles, in the summer and autumn months, but was apparently absent between October and May.

Remarks.—These specimens show one point of difference from the account given by Hansen. The corner of the basal joint of the male pleopods is setose and not smooth. There are three setae, one long and plumose, one long and simple, and one short. In all other respects they agree with *A. typica* as redescribed by Hansen.

Anchialina grossa, Hansen.

A. grossa, Hansen, 1910, 1912.
A. grossa, Tattersall, 1922.
A. frontalis, Zimmer, 1915.

Occurrence.—Low Isles Anchorage, 28.vi.29, small coarse townet at night, 1 immature female.

Stn. 67, 3 mi. E. of Low Isles, 17.vii.29, stramin net, 1 immature female.

Distribution.—East Indies, Bay of Bengal, Gulf of Siam (Hansen, 1910); Gilbert Islands (Hansen, 1912); between Ceylon and New Guinea (Zimmer, 1915); Andaman Isles (Tattersall, 1922).

Genus *Gastrosaccus*, Norman.

Gastrosaccus, sp. ?.

Occurrence.—Low Isles Anchorage, 29.xi.28, coarse townet at surface, moonlight, 1 very small specimen.

Low Isles Flat, 23.v.29, small coarse townet at night, 3 immature specimens.

Low Isles Flat, 7.vi.29, 1 small specimen.

Stn. 65, 3 mi. E. of Low Isles, coarse silk townet at surface at night, 2 small specimens.

Remarks.—All the specimens are immature and there are no males. It is, therefore, impossible to identify them with any certainty. The characters of the rostrum and

telson suggest that they belong to *G. indicus*, Hansen, rather than to *G. parva*, Hansen, two species known from the Siboga collections, and likely to occur in the Barrier Reef region. The telson has 9–10 spines on the lateral margins, and the rostrum is practically absent—points in which the specimens resemble *G. indicus*. All the specimens were captured in night townettings.

Genus *Pseudanchialina*, Hansen.

Pseudanchialina pusilla (G. O. Sars).

> *Anchialus pusillus*, G. O. Sars, 1885.
> *Pseudanchialina pusilla*, Hansen, 1910.

OCCURRENCE.—Low Isles Flats, 16.xi.28, 20 specimens.

Low Isles Anchorage, 29.xi.28, coarse townet at surface, moonlight, about 50 specimens, adults of both sexes, the females carrying eggs.

REMARKS.—I was unable to make out the lateral free wings on the first abdominal somite of the female. Hansen likewise could not detect them in his specimens. In all other respects my specimens agree with Hansen's re-description of Sars's species.

DISTRIBUTION.—Celebes Sea (Sars, 1885); East Indies (Hansen, 1910); Bay of Bengal (Hansen, 1910).

Sub-Family MYSINAE.

Tribe ERYTHROPINI.

Genus *Erythrops*, G. O. Sars.

Erythrops yongei, sp. nov. (Text-fig. 2.)

OCCURRENCE.—Stn. 50, outside Papuan Pass, 18.iii.29, 1 m. stramin net, 400 m. to surface, 1 female, 5 mm.

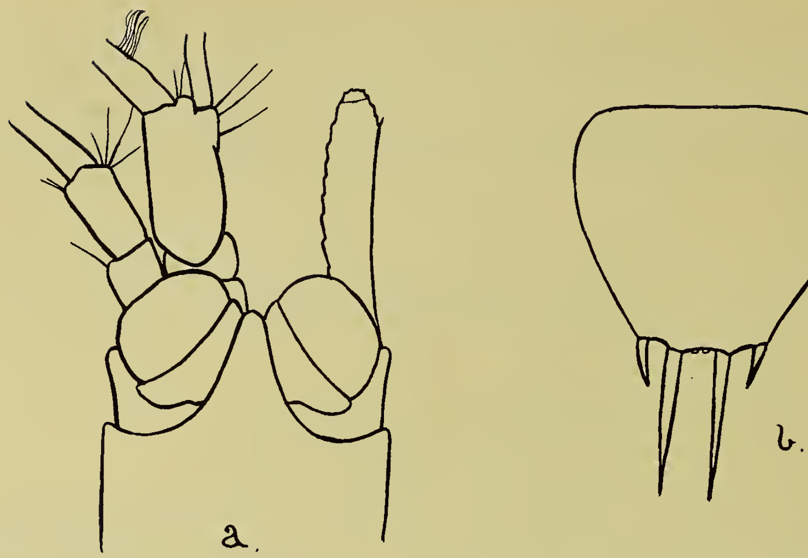
DESCRIPTION.—*Carapace* (Text-fig. 2*a*) produced in front into a moderately long obtuse rostral plate extending forwards almost to the distal margins of the eyes.

Eyes (Text-fig. 2*a*) not depressed or kidney-shaped, rather small, subglobose in shape, pigment black.

Antennal scale (Text-fig. 2*a*) extending forward to the level of the distal end of the antennular peduncle, rather narrow, about five times as long as broad, outer margin terminating in a spine beyond which the apex of the scale extends for a short distance, a small distal joint marked off by a distinct suture.

Telson (Text-fig. 2*b*) of the typical shape for the genus, about as long as broad at the base; apex armed with two pairs of spines, the inner pair about four times as long as the outer pair, the pair of plumose setae between the inner spines broken, so that it is not possible to estimate their length.

REMARKS.—This species is a typical member of the genus *Erythrops*, but appears to differ from other described forms (1) in the character of the rostral plate and (2) in the small eyes, which are not depressed and kidney-shaped. The characters of the antennal scale and telson will also help to identify it, the apical spines of the latter being less robust in form than is usual in other species.



Text-fig. 2.—*Erythrops yongei*, sp. nov. *a*, Anterior end to show rostral plate, eyes, and antennal scale, × 56 ; *b*, telson, × 112.

Genus *Hypererythrops*, Holt and Tattersall.

Hypererythrops spinifera (Hansen).

Erythrops spinifera, Hansen, 1910.
Hypererythrops spinifera, Tattersall, 1922.

Occurrence.—Stn. 29, outside Trinity Opening, 24.xi.28, 200 fms., bottom stramin net, 8 males and 6 females, all adult.

Stn. 65, Reef Lagoon, 10.vii.29, coarse townet at 20·7 m., 2 damaged specimens.

Remarks.—The material of this species is in very poor condition but, as far as can be seen, the specimens agree very closely with those which I examined from India. The telson has both plumose setae and a pair of minute spines between the large pair of apical spines, exactly as I have described in the India material. The rostrum appears to be more pointed than in the specimens I had previously examined, and the antero-lateral angles of the carapace are acute.

Distribution.—East Indies (Hansen, 1910) ; Andaman Isles (Tattersall, 1922).

Genus *Synerythrops*, Hansen.

Synerythrops intermedia, Hansen ?. (Text-fig. 3.)

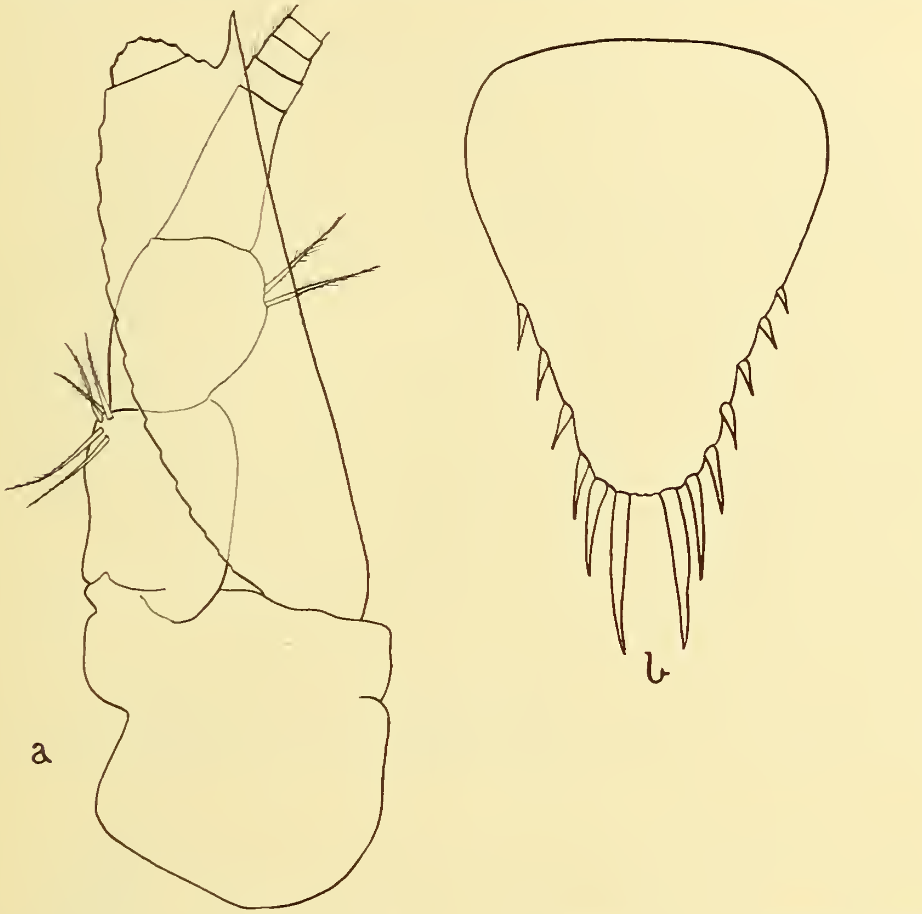
S. intermedia, Hansen, 1910.

Occurrence.—Stn. 29, outside Trinity Opening, 24.xi.28, bottom stramin net, 1 adult male, 1 immature male, and 2 females, 5–7 mm.

Remarks.—The specimens are in a poor state of preservation. They differ from the description and figures given by Hansen in two respects. Firstly, the eyes appear to me to be slightly depressed and to have the kidney-shape characteristic of *Erythrops*. Hansen describes the eyes of *S. intermedia* as not depressed and subglobose in shape. Secondly, Hansen's figure of the telson shows the spines arming the margins to be confined to the distal quarter of the margins. In the present specimens the spines extend over at least

the distal half of the margins and are slightly more numerous, six to seven on each side, as against five in Hansen's specimens.

Otherwise the material agrees rather closely with the description and figures given by Hansen. I refer it provisionally to his species, and give figures (Text-figs. 3*a* and 3*b*) of



TEXT-FIG. 3.—*Synerythrops intermedia*, Hansen. *a*, Antennal scale, × 94 ; *b*, telson, × 94.

the antennal scale and telson of one of my specimens. I may add that the pleopods of the male conform to the type found in the genus *Erythrops*, and that the statocyst of the inner uropods has two spines on the lower inner corner.

DISTRIBUTION.—Known hitherto only from the waters of the Dutch East Indies, where it was collected by the " Siboga " Expedition.

Genus *Katerythrops*, Holt and Tattersall.

Katerythrops sp. ?.

OCCURRENCE.—Stn. 29, outside Trinity Opening, 24.xi.28, bottom stramin net, 1 specimen, 4 mm.

REMARKS.—The specimen is too damaged to admit of identification and description. It has the short and broad telson characteristic of *K. parva*, Zimmer, and *K. tattersalli*, Illig, rather than the more elongate and narrow form of telson found in *K. oceanae*, H.

& T. I can detect traces of only four spines at the apex of the telson—a feature in which the specimen resembles *K. tattersalli*—but the antennal scale is shorter than in the latter species, extending forwards only to the level of the distal end of the antennular peduncle. None of the thoracic limbs remain on the specimen.

Genus *Metamblyops*, Tattersall.

Metamblyops stephensoni, sp. nov. (Text-fig. 4.)

Occurrence.—Stn. 29, outside Trinity Opening, 24.xi.28, bottom stramin net, 11 males, 9 females and 2 immature specimens, 7 mm.

Description.—The material is in very poor condition. None of the thoracic limbs posterior to the second pair remain on any of the specimens. The mouth-parts and the first and second thoracic limbs (Text-figs. 4*c* and 4*d*) are typically of the *Erythrops* form, and present no features of special interest. The pleopods of the male also conform to the type found in the same genus, the first pair with a normal exopod and small endopod, the remaining pairs with well-developed exopods and endopods of equal length and without any modified setae or spines on any of the series. The genus *Metamblyops* is distinguished from the remaining genera of the Erythropini (1) in having the eye normal in form, subglobose and not depressed, without finger-like processes of any kind, and with normal pigment, and (2) in the form of the telson, which is lanceolate or linguiform in shape without an apical cleft, the margins armed with more or fewer spines, apical plumose setae absent. The present material agrees with *Metamblyops* in both these characters. It may be distinguished from the only other species of the genus, *M. oculata* (Tattersall, 1911), by the characters of the rostral plate, antennal scale and the telson.

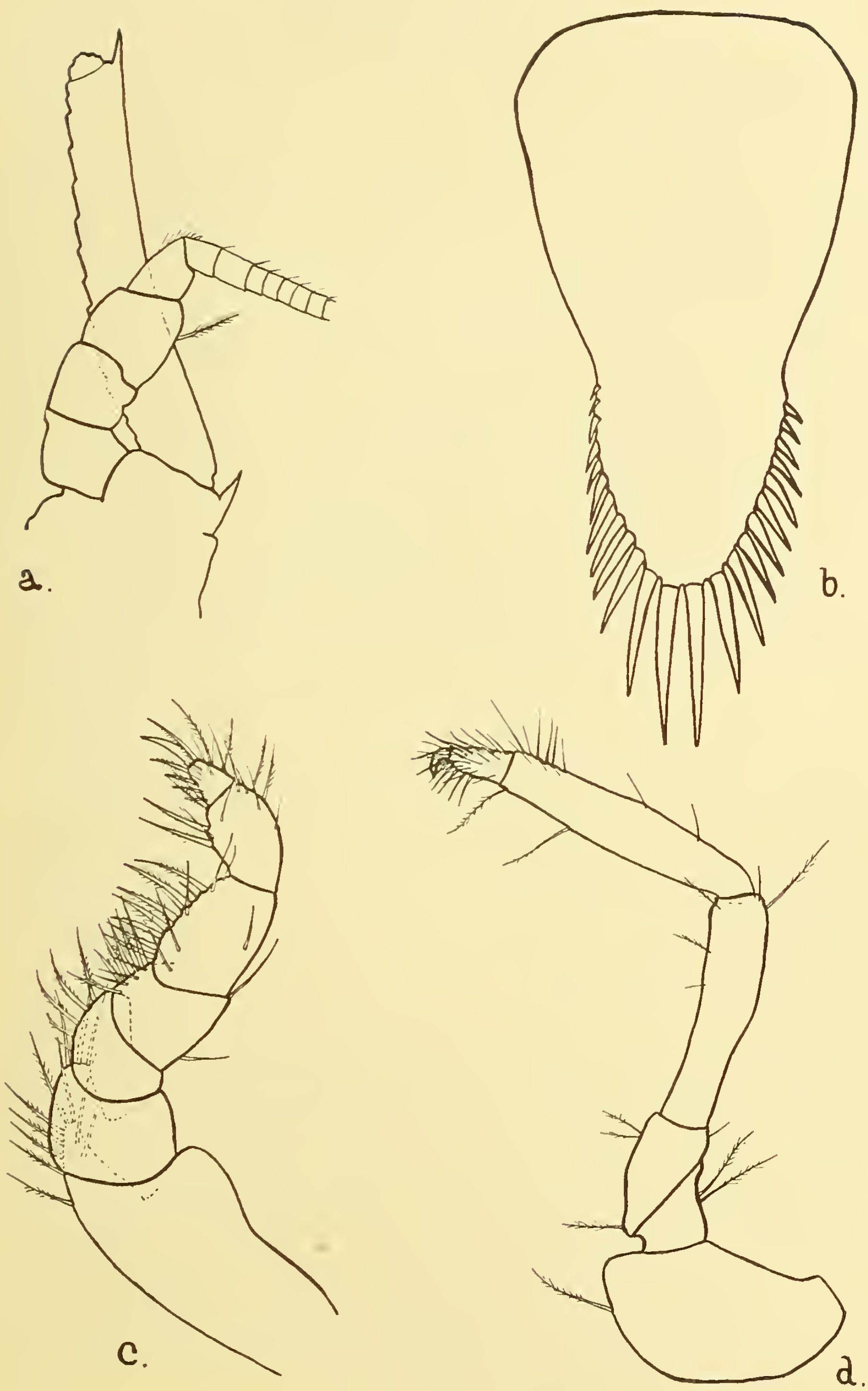
The carapace is broadly arcuate and rounded in front, and not produced into a rostral plate.

The antennal scale (Text-fig. 4*a*) is rather long and narrow, about seven times as long as broad, outer margin entire and terminating in a strong spine, which projects beyond the apex of the scale. There is a distinct terminal joint marked off by a suture.

The telson (Text-fig. 4*b*) is triangular in shape, not quite twice as long as broad at the base, and narrowing to a bluntly rounded apex. The distal third of the margins is armed by a series of eleven stout spines, gradually increasing in length to the apex, the pair of spines at the apex about one-third of the length of the entire telson. Proximal to the spines the telson narrows somewhat, and there is no trace of apical plumose setae. The inner uropod has two spines on the statocyst.

M. stephensoni differs from *M. oculata* in three main points: Firstly the rostral plate is virtually absent, whereas in *M. oculata* the rostral plate is long, acutely pointed and extends forwards beyond the eyes. Secondly, the antennal scale is shorter and narrower than in *M. oculata*, where it is only three and a half times as long as broad, and extends for one-third of its length beyond the antennular peduncle. Thirdly, the telson is armed with many fewer but much stouter spines. In *M. oculata* the lateral margins of the telson are armed with about thirty spines.

M. oculata is known only from deep water off the west of Ireland. The occurrence of a second species of the genus in deep water off Australia is therefore a matter of interest from the point of view of geographical distribution.



Text-fig. 4.—*Metamblyops stephensoni*, sp. nov. *a*, Antennal scale, × 56 ; *b*, telson, × 112 ; *c*, endopod of the first thoracic limb, × 94 ; *d*, endopod of the second thoracic limb, × 64.

Tribe LEPTOMYSINI.

Genus *Doxomysis*, Hansen.

Doxomysis littoralis, Tattersall.

D. littoralis, Tattersall, 1922.

Occurrence.—Stn. 59, 3 mi. E. of Low Isles, 31.v.29, 1 m. stramin net, 1 female.
Low Isles Anchorage, 28.vi.29, small coarse townet at night, 1 female.
Stn. 65, 3 mi. E. of Low Isles, coarse silk townet at night, 18 specimens.

Remarks.—I can find no valid characters to separate the Barrier Reef specimens from *D. littoralis*. Some of the specimens appear to be faintly spinulose, but the material is not well preserved, and I cannot be sure of this character. When describing *D. littoralis* I noticed some specimens which had the body covered by minute spinules, and thought that perhaps they represented an undescribed species. The occurrence at the Barrier Reef of specimens which are apparently smooth and others which are faintly spinulose suggests that the spinules may be rubbed off to varying degrees in the process of collection, and cannot be relied upon as a specific character for this reason. It would seem from these observations that *D. littoralis* is really a faintly spinulose form, and that smooth specimens represent those which have been more or less damaged by collection.

Distribution.—Known hitherto only from Port Blair, Andaman Islands (Tattersall, 1922).

Genus *Promysis*, Dana.

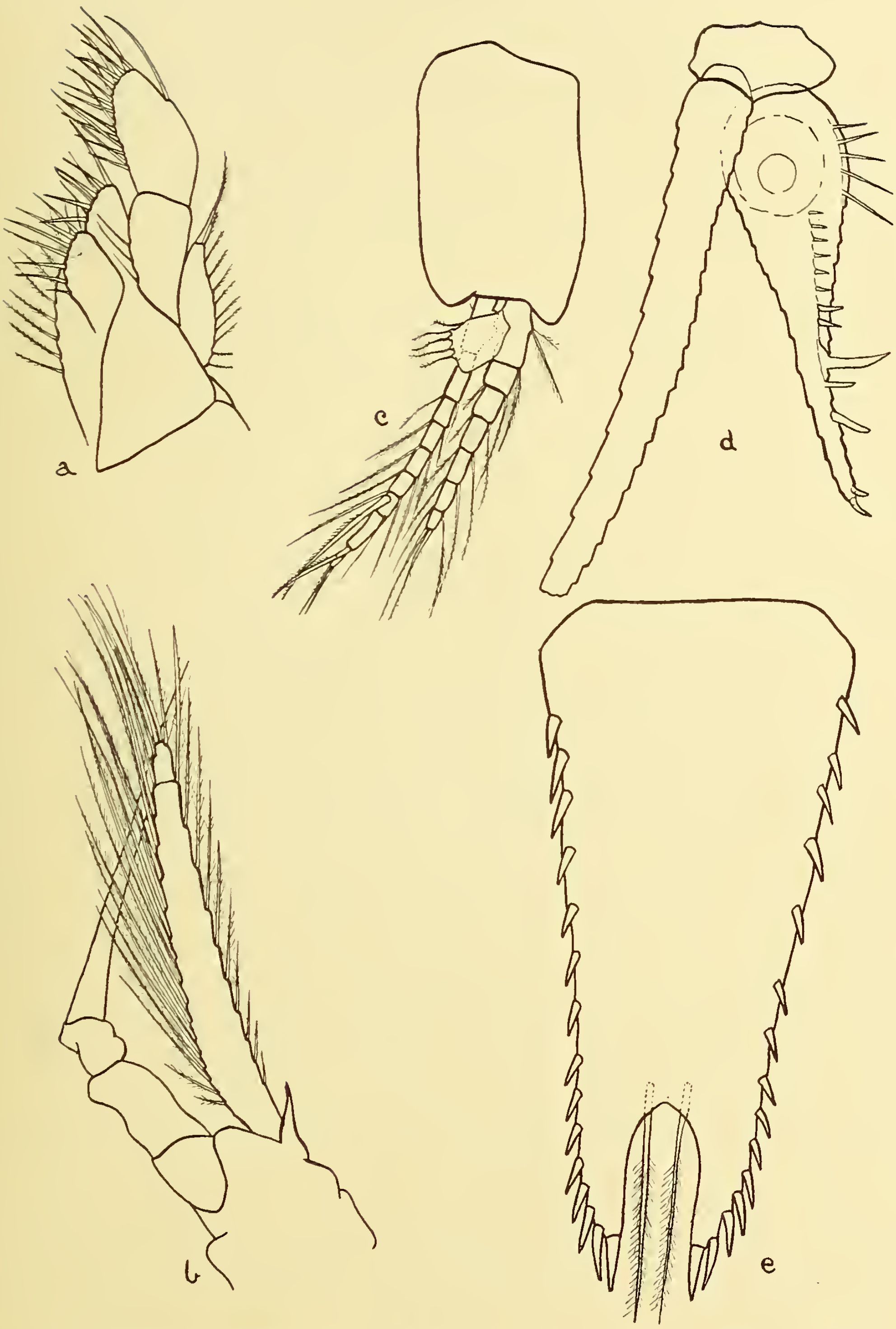
Promysis orientalis, Dana. (Text-fig. 5.)

Promysis orientalis, Dana, 1852.
P. orientalis, Czerniavsky, 1883.
Uromysis armata, Hansen, 1910.
U. armata, Zimmer, 1915.
U. armata, Colosi, 1918 and 1920.
Promysis armata, Tattersall, 1922.

Occurrence.—With *Anchialina typica*, one of the most abundant and characteristic Mysids of the Barrier Reef Lagoon. It occurred in considerable numbers at the weekly plankton station, 3 mi. E. of Low Isles in both day and night townettings, in the summer and autumn months, but appeared to be absent or very scarce between September and May.

Remarks.—The most important difference between these specimens and Hansen's description and figures is the presence of a pair of plumose setae at the base of the cleft of the telson (Text-fig. 5*e*). These setae are to be found in all my specimens. Hansen states that such setae are absent in his specimens, but Zimmer (1915) notes their presence in the specimens examined by him. I can only conclude that they had been accidentally broken off in the specimens recorded by Hansen.

Other minor differences are to be found between these specimens and the description and figures of Hansen. The second maxilla has eleven setae on the margin of the exopod (Text-fig. 5*a*), whereas Hansen figures only three. The telson (Text-fig. 5*e*) has about fifteen spines on the lateral margins—rather more than in Hansen's specimens. These differences are readily attributable to differences in size. Hansen gives the size of adult



TEXT-FIG. 5.—*Promysis orientalis*, Dana. *a*, Maxilla, × 56 ; *b*, antennal scale, × 56 ; *c*, fourth pleopod of the male, × 56 ; *d*, uropods, × 56 ; *e*, telson, × 112.

specimens as 4 mm. for the male and 3·5 mm. for the female. My largest specimens are between 6 and 7 mm. in length. Hansen's figures for the mouth-parts of the species are taken from immature specimens.

The examination of these specimens raises once more the question as to the identity of Hansen's species with the earlier *P. orientalis*, Dana. In 1923, when pointing out that the genus *Uromysis*, Hansen, was certainly the same as *Promysis*, Dana, I hinted at the specific identity of Hansen's and Dana's species. One important difference between them, that of size, disappears in the light of the present material. It is very doubtful if the other differences between the two species, which I referred to in my earlier paper, can be regarded as of sufficient importance to be of specific rank. Unfortunately Dana's types are no longer available, and the point can never be satisfactorily cleared up. The areas of geographical distribution of the two species coincide, and there remains no legitimate reason for keeping them apart. I have, therefore, here taken the further step of uniting the two species under the earlier name of *P. orientalis*.

Distribution.—East Indies (Hansen, 1910); between Ceylon and New Guinea (Zimmer, 1915); China Sea (Colosi, 1918 and 1920).

Genus *Pseudomysidetes*, nov.

Definition.—Closely allied to *Mysidetes*, Holt and Tattersall. *Carapace* anteriorly broadly and evenly rounded, not produced into a rostral plate. *Eyes* large, cornea as large as the stalk, pigment black. *Antennules* with a prominent blunt spine on the outer margin of the first joint. *Antennal scale* broadly lanceolate, setose all round, with a distal transverse suture. *Maxillae* having the terminal joint of the palp powerfully and unusually armed, the proximal half of the inner margin with about fifteen short stout spines, the distal half with a row of five large triangular serrate spines and a single terminal simple spine. Exopod very small, with ten or eleven setae on the outer margin. *First thoracic limbs* (maxillipeds) very powerful, the lobe from the second joint unusually large, that from the third hardly perceptible, that from the fourth joint small but clearly developed; seventh joint short and expanded; apex armed with seven strong spines in addition to a few short, plumose setae. *Second thoracic limbs* (gnathopods) much more slender than the first, second joint broadly expanded, seventh joint terminating in two strong spines. *Third to the eighth thoracic limbs* showing a progressive reduction in the length of the endopod (third to seventh joints). In all, the second joint of the endopod is a large, broadly expanded plate. Sixth joint of the endopod divided into five sub-joints in the third limb, four in the fourth to the seventh, and three in the eighth. Dactylus simple in the third and fourth limbs, absent from the remainder. Male appendage on the eighth thoracic limb very long, and extending forward almost to the mouth. *Pleopods* of the male simple plates as in the female. *Telson* long and narrowly lanceolate in shape; apex entire, without cleft or plumose setae; distal portions of the lateral margins armed with a row of regular short spines; apex armed with a pair of longer spines between which is a pair of minute spinules.

Type-Species.—*Pseudomysidetes russelli*, sp. nov.

Remarks.—This remarkable genus comes nearest to the genus *Mysidetes*, with which it agrees in having the pleopods of both sexes alike, a series of simple plates, and in the great development of the male appendages of the last thoracic limbs and in the form of

the antennal scale. It differs from *Mysidetes* (1) in the quite unique armature of the distal joint of the palp of the maxillae ; (2) in the peculiar form of the thoracic limbs showing a gradual reduction in the size of the endopod (third to seventh joints), until in the last limb the endopod, with the exception of the second joint, is a small slender appendage ; (3) in the form of the telson, long and narrow, without apical cleft or plumose setae.

Pseudomysidetes russelli, sp. nov. (Text-figs. 6–8.)

Occurrence.—Stn. 29, 24.xi.28, bottom stramin net. Twenty specimens, 14 males, 2 females and 4 immature specimens, 8–11 mm.

Description.—General form of the body robust. Carapace (Text-fig. 6*a*) rather strongly vaulted, broadly rounded in front and not produced into a rostral plate, leaving the eyes and eyestalks and the antennular peduncle completely uncovered.

Eyes (Text-fig. 6*a*) large, stalks rather short, and about equal in length to the large corneal portion of the eye.

Antennular peduncle (Text-fig. 6*b*) robust, first and third joints about equal in size, second joint much shorter ; first joint with a prominent blunt spine on the outer margin.

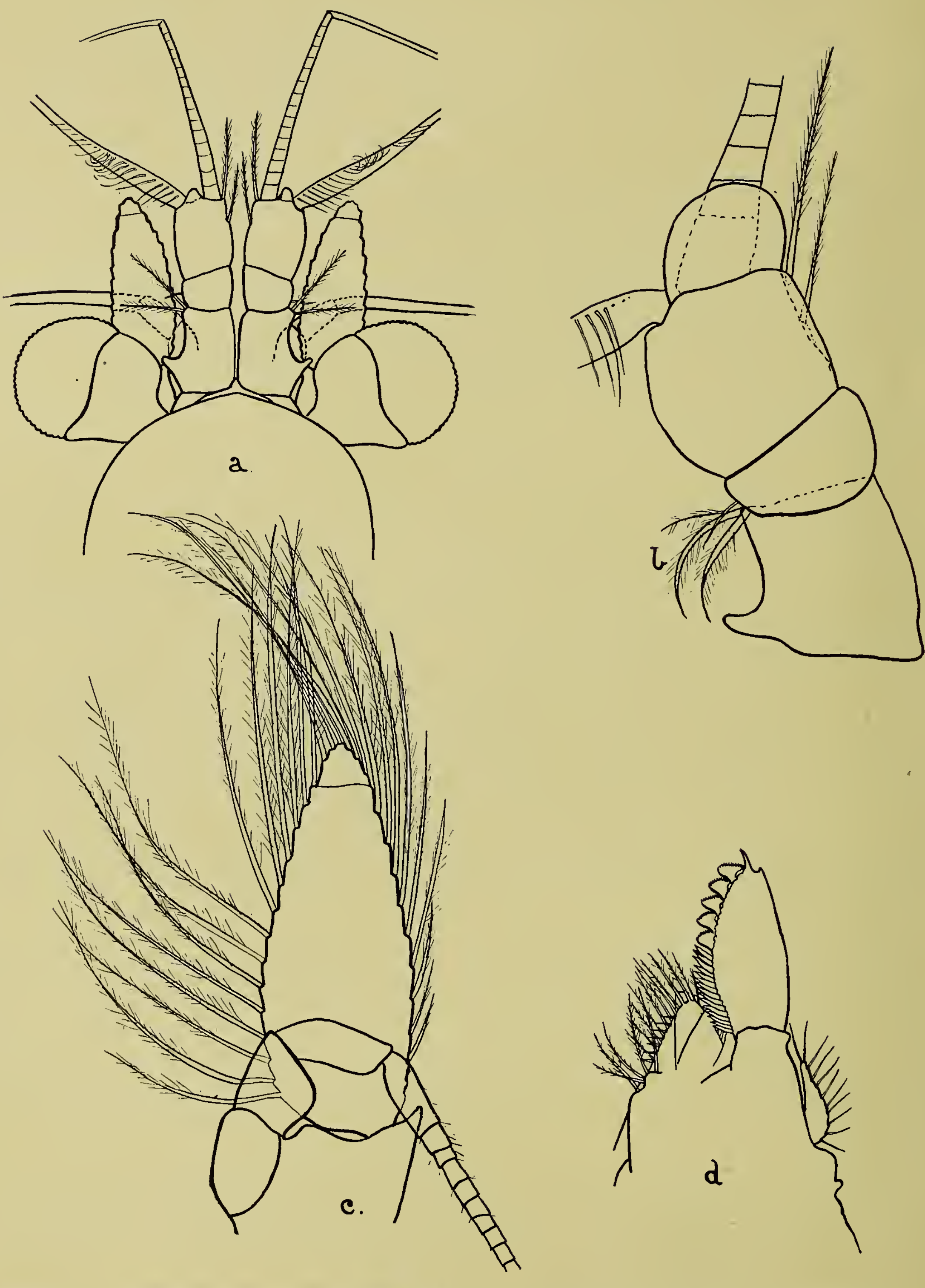
Antennal scale (Text-fig. 6*c*) short, extending forward to the level of the distal end of the antennular peduncle, two and two-thirds times as long as broad, with a small but distinct terminal joint marked off by a distinct suture, setose all round, the setae long and plumose ; peduncle short, first two joints robust and subequal, third joint longer than the first and second, and much narrower.

Mouth-parts strongly built, but only the maxilla calls for any special comment. This appendage (Text-fig. 6*d*) is chiefly remarkable for the armature of the distal joint of the palp. The inner margin of this joint is armed proximally with about fifteen strong but simple spines very closely set, and distally by five very powerful triangular spines strongly serrated, and a distal simple spine. I know of no other Mysid in which the maxilla possesses anything like this peculiar and powerful armature. It serves at once to distinguish the species. The exopod is small and feebly developed, with about ten setae on the outer margin.

First thoracic limbs (maxillipeds) (Text-fig. 7*e*) robust and powerfully developed, gnathobasic endite of the second joint of the endopod very large and well developed, with a group of about a dozen long plumose setae and two short stout spines on the distal margin ; gnathobasic endite almost absent from the third joint, but quite conspicuous on the fourth ; terminal joint of the endopod short and broadly expanded, the distal margin armed with six or seven stout spines, one or two slender spines and a group of plumose setae ; distal corners of the broadly expanded basal joint of the exopod rounded, without spines.

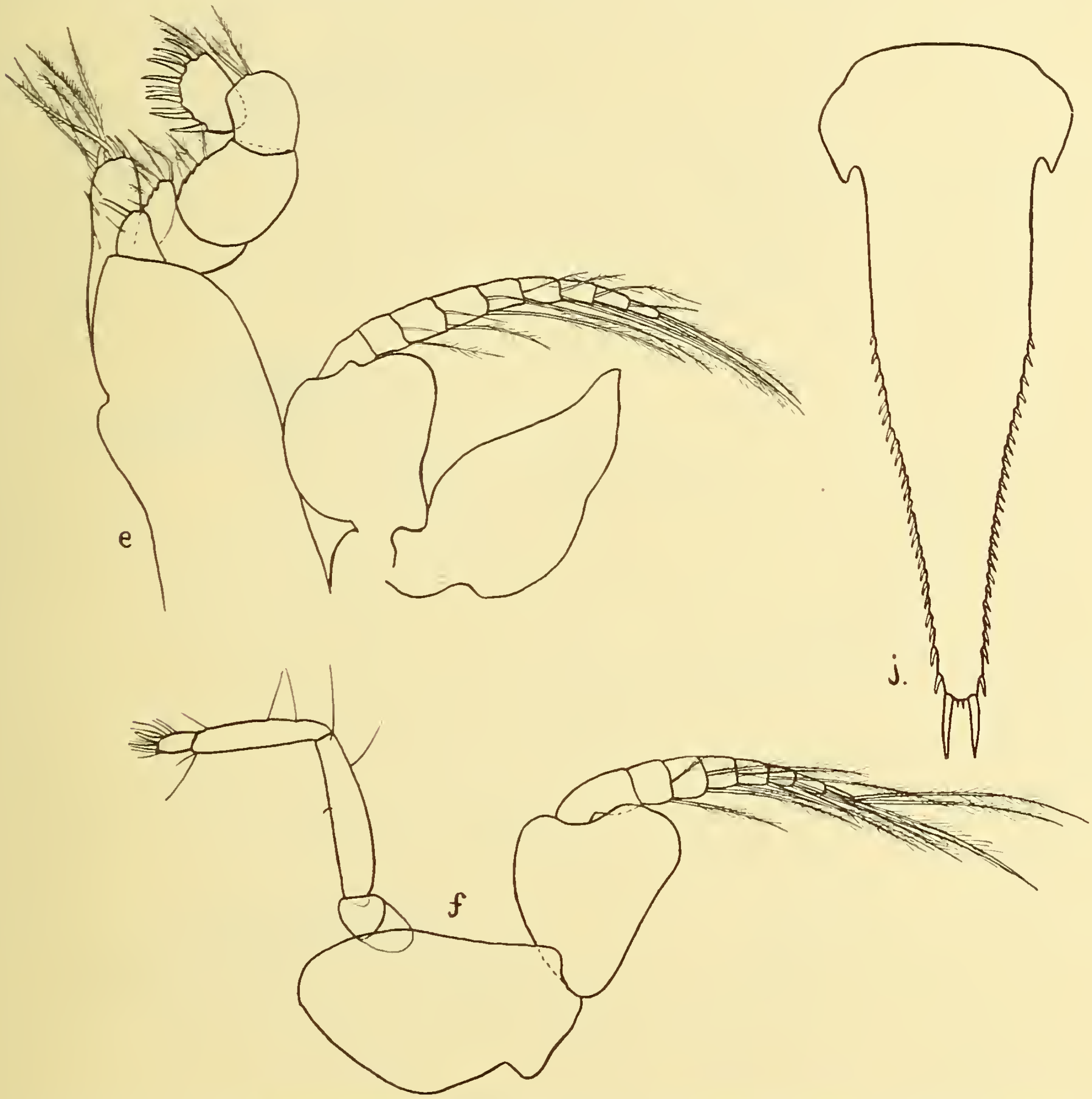
Second thoracic limbs (gnathopods) (Text-fig. 7*f*) with the endopod rather short and slender ; second joint very large and expanded into a broad plate ; third and fourth joints short ; fifth joint elongate, a little longer than the sixth ; seventh joint short, and terminating in two strong spines and a few simple setae.

Third and fourth thoracic limbs (Text-fig. 8*g*) very similar to one another ; second joint of the endopod much expanded ; long fine plumose setae on the margins of the fourth and fifth joints ; sixth joint divided into five subjoints in the third limb and four in the fourth ; seventh joint a simple dactylus.



TEXT-FIG. 6.—*Pseudomysidetes russelli*, gen. et sp. nov. *a*, Anterior end to show rostral plate, eye, antennular peduncle and scale, × 24 ; *b*, antennular peduncle, × 56 ; *c*, antennal scale and peduncle, × 56 ; *d*, maxilla, × 56.

Fifth to the eighth thoracic limbs (Text-figs. 8*h* and 8*i*) showing a progressive reduction in the size of the endopod ; second joint of the endopod in all greatly expanded as a flat plate ; sixth joint of the endopod divided into four subjoints in the fifth to the seventh limbs, with a gradual reduction of the fourth subjoint till in the eighth limb it disappears altogether, and the sixth joint of the endopod of this limb has only three subjoints ;

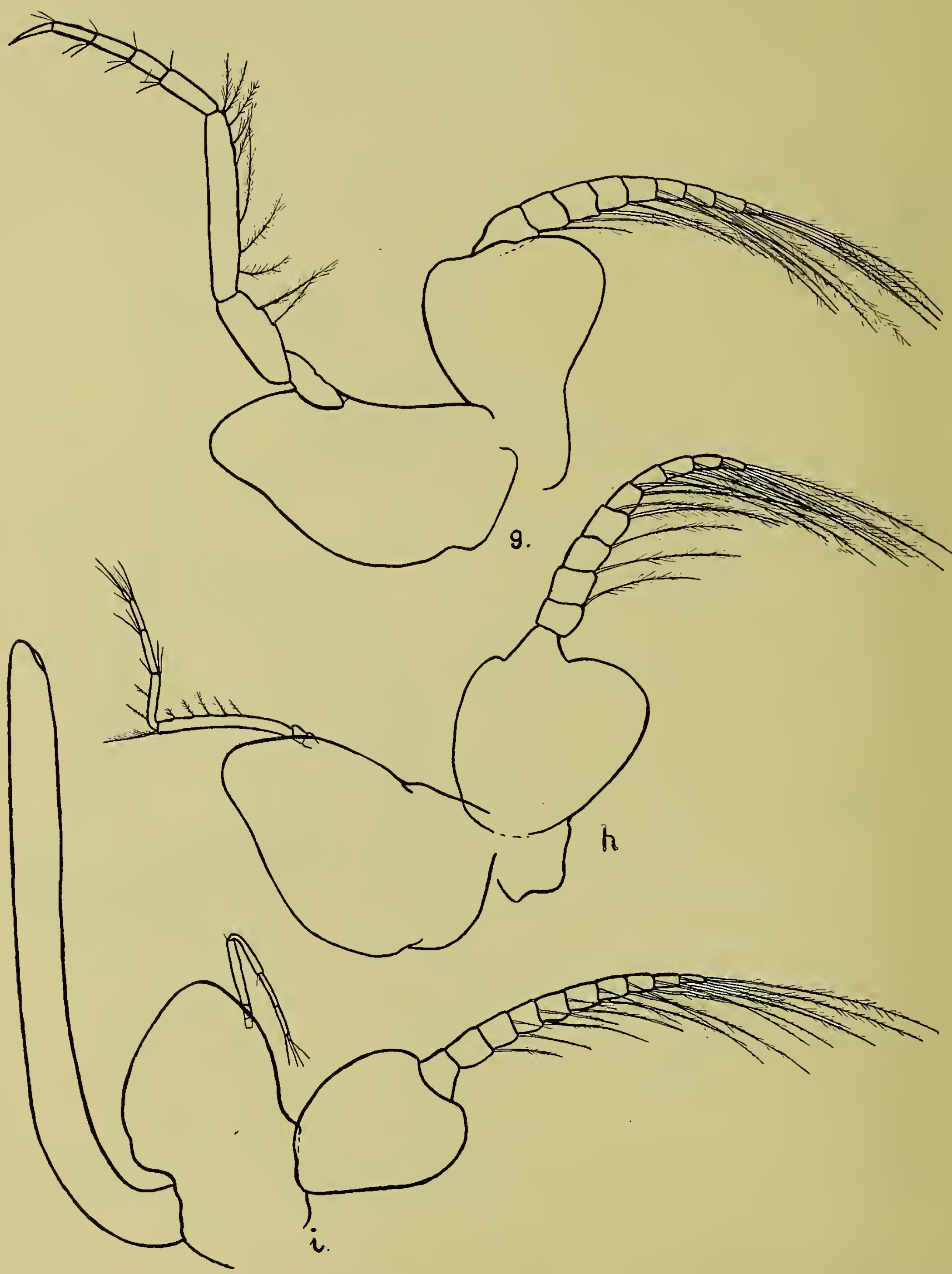


TEXT-FIG. 7.—*Pseudomysidetes russelli*, gen. et sp. nov. *e*, First thoracic limb, × 56 ; *f*, second thoracic limb, × 45 ; *j*, telson, × 56.

dactylus absent in all. The male appendage of the eighth limb is very long and well developed, and extends forward almost as far as the mouth.

Pleopods in both sexes alike, consisting of small simple plates without sexual differences.

Telson (Text-fig. 7*j*) long and narrowly lanceolate in form, two and a half times as long as broad at the base ; a short distance distal to the base there is a well-marked



TEXT-FIG. 8.—*Pseudomysidetes russelli,* gen. et sp. nov. *g*, Fourth thoracic limb, × 45 ; *h*, fifth thoracic limb, × 45 ; *i*, eighth thoracic limb, × 45.

shoulder defined by a blunt process on each margin, behind which the telson suddenly narrows to a short truncate apex, which is entire and without apical cleft or plumose setae, equal in breadth to about one-twentieth of the length of the telson and armed by a pair of long, strong spines, one at each corner, between which is a pair of minute spinules; rather more than half of the lateral margins of the telson armed distally with a regular series of twenty-five short spines.

Uropods, inner, one and a half times as long as the telson, without spines on the inner margin; outer twice as long as the telson.

Length of an adult male, 11 mm., of an immature female, 8 mm.

Remarks.—The combined characters of the antennal scale, telson, maxilla and the very peculiar condition of the thoracic limbs will serve to distinguish this species from any other described form. It is clearly a member of the Leptomysini, most closely allied to *Mysidetes* by the characters of the pleopods in both sexes and by the enormous development of the male appendage of the eighth thoracic limbs.

Tribe Mysini.

Genus *Anisomysis*, Hansen.

Anisomysis laticauda, Hansen.

A. laticauda, Hansen, 1910.
A. laticauda, Zimmer, 1915.

Occurrence.—Stn. 63, 3 mi. E. of Low Isles, 24.vi.29, coarse townet, 1 adult female, 4 mm.

Stn. 65, Barrier Reef Lagoon, 10.vii.29, coarse townet at 8 m. and at 15·5 m., 2 adult females, 4 mm.

Distribution.—Hitherto known from 1 male specimen captured by the "Siboga" Expedition in the waters of the Dutch East Indies.

Anisomysis incisa, sp. nov. (Text-fig. 9.)

Occurrence.—Low Isles Anchorage, 16.xi.28, coarse townet at 7.30 p.m., by moonlight, 8 adult males and 14 adult females, 4 mm.

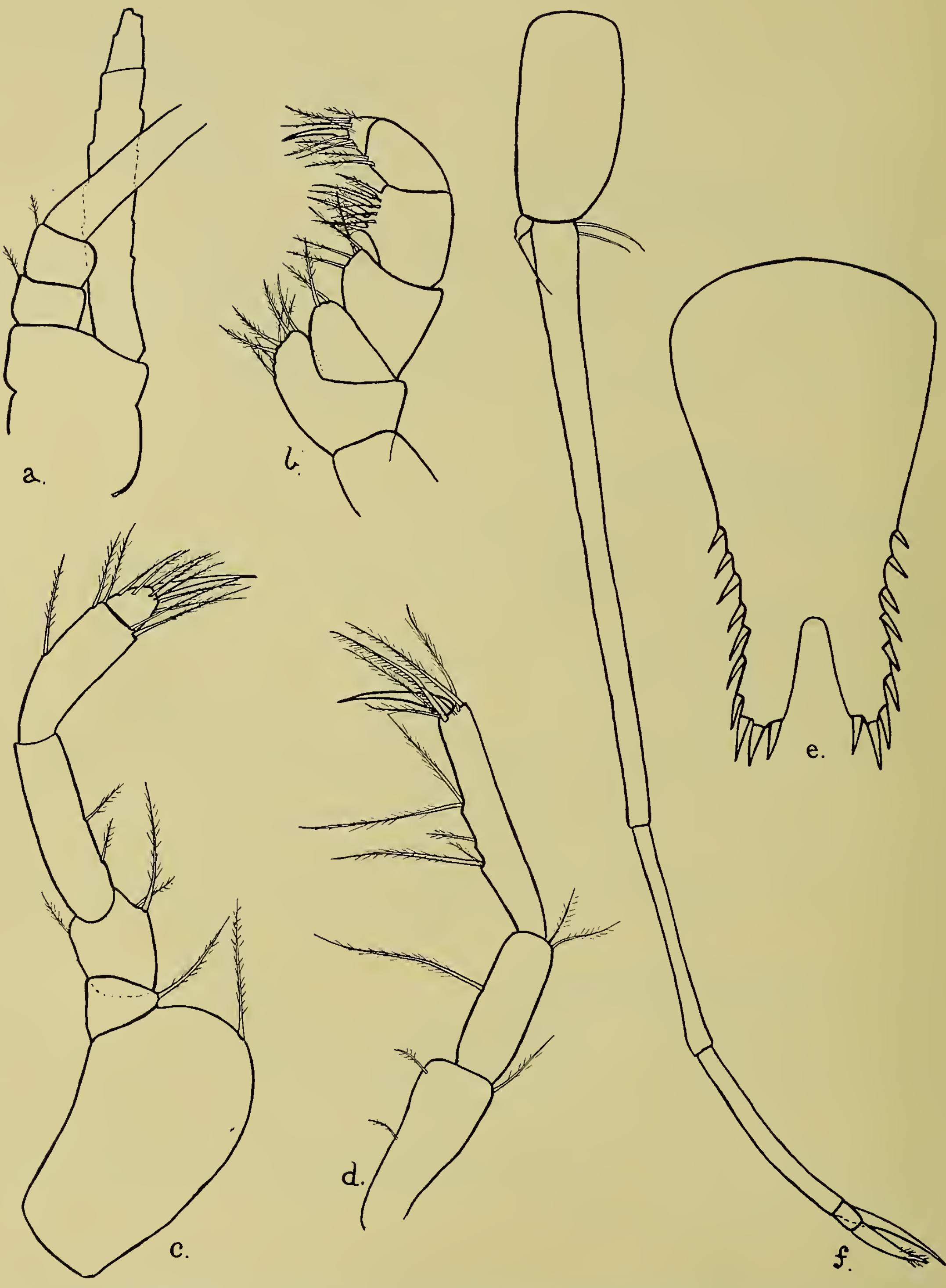
Stn. 65, Barrier Reef Lagoon, 10.vii.29, coarse townet at 12·5 m., by night, 1 adult male.

Description.—*Carapace* covering the whole of the thorax, produced in front into a short, broadly rounded rostral plate.

Eyes large, pigment black.

Antennal scale (Text-fig. 9*a*) extending forward as far as the distal end of the antennular peduncle, seven times as long as broad, setose all round; terminal joint about one-sixth of the entire length of the scale.

Thoracic limbs.—The form of the endopod of the first and second thoracic limbs is shown in the accompanying figures (Text-figs. 9*b*, *c*). The sixth joint of the endopod of the third to the eighth thoracic limbs is undivided (Text-fig. 9*d*).



TEXT-FIG. 9.—*Anisomysis incisa*, sp. nov. *a*, Antennal scale and peduncle, × 134; *b*, endopod of the first thoracic limb, × 244; *c*, endopod of the second thoracic limb, × 244; *d*, distal part of the endopod of the third thoracic limb, × 244; *e*, telson, × 244; *f*, fourth pleopod of the male, × 134.

Sixth abdominal somite one and a half times as long as the fifth.

Telson (Texth-fig. 9*e*) as long as the sixth somite of the abdomen, not quite twice as long as broad at the base; apex cleft for about one-quarter of the length of the telson, cleft unarmed; apical lobes of the telson armed with three subequal spines; distal half of the lateral margins armed with six or seven spines in addition to those of the apical lobes.

Uropods nearly twice as long as the telson and subequal to each other.

Fourth pleopod of the male (Text-fig. 9*f*) extending backwards to level of the apical lobes of the telson, distal peduncular joint twice as long as broad; exopod three-jointed, the proximal joint three times as long as the distal, which is slightly shorter than the second joint; third joint ending in two processes, one rather stout 2-jointed and fringed with setae on the distal part, the other more slender and spiniform.

Length of adult specimens of both sexes, 4 mm.

REMARKS.—This species is at once distinguished by the form of the telson with its rather deep unarmed apical cleft. It admits of no confusion with any other described species of the genus.

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EUPHAUSIACEA.

INTRODUCTION.

The collection of Euphausiacea made by the Great Barrier Reef Expedition is a small one, comprising sixteen species, fourteen of which are identified with existing species, and two represent larval forms which could not be referred to the adult stage. None of the species is new to science.

The area investigated by the Expedition has hitherto received very little attention apart from the corals themselves, and I am unaware of any collections of Euphausians from this locality. In this respect, therefore, the material, though somewhat scanty, fills in a gap in our knowledge of the geographical distribution of the species, and of the type of fauna of a hitherto unexamined region.

Twelve of the fourteen identified species were captured by the "Siboga" Expedition, which operated mainly in the waters of the Dutch East Indies, and the remaining two known forms are tropical species which might have been expected in the same area and actually occur in other parts of the Pacific. The Euphausian fauna of the Barrier Reef region is thus continuous with that of the sea immediately to the north of it—a typical tropical fauna.

All the species but one are oceanic forms, widely distributed in tropical waters. The exception, *Pseudeuphausia latifrons*, is a shallow-water coastal form, quite widely distributed in the Pacific, but always near to land and never under oceanic conditions. This species is the dominant one, in fact, the only form which is characteristic of the shallow lagoon area inside the reef. It occurred regularly throughout the year in the townettings at the weekly station. It also occurred in the hauls taken in the channels leading through the reef to the deep water beyond, but it was only taken twice in any of the gatherings made at stations outside the 100 fms. line.

The material yielded a fairly complete series of larval stages, which have enabled me to elucidate the life-history of the species. The life-history is closely parallel to that of *Nyctiphanes*, and suggests that the genus *Pseudeuphausia* is nearer to *Nyctiphanes* than to *Euphausia*, under which genus the species was first described.

From July to October, 1928, the lagoon was invaded by small numbers of oceanic species of Euphausians. Five such species occurred at the weekly station : *Thysanopoda tricuspidata* (eleven times), *Thysanopoda* sp. (larval stages, once), *Euphausia tenera* (seven times), *Nematoscelis microps* (once), and *Stylocheiron carinatum* (twice). These are oceanic forms characteristic of the upper 200 metres of water. No oceanic species occurred in the lagoon area from 22nd October, 1928, to the conclusion of the expedition in July, 1929. I am unable to offer any explanation of this curious fact. The remaining species of Euphausians were taken at those stations situated in the deep channels running in from openings in the reef, or in deep water outside the barrier.

In recording the larval forms of Euphausians I have used the nomenclature of Dr. Lebour (1926*a*) to indicate the stage of development reached by the Furcilia larvae. For instance, in recording Furcilia 10 under *Thysanopoda tricuspidata*, I mean to convey that the specimen in question has reached the stage of development of the pleopods corresponding

to Furcilia 10 of Lebour's nomenclature, namely, two setose and two non-setose pairs of pleopods. I do not intend to convey the meaning that the stage in question represents the tenth Furcilia stage of the species. I have used Lebour's nomenclature in this sense throughout this paper.

SYSTEMATIC ACCOUNT.

Order EUPHAUSIACEA.

Family Euphausiidae.

Genus *Thysanopoda*, H. M.-Ed.

1. *Thysanopoda tricuspidata*, H. M.-Ed.

T. tricuspidata, Sars, 1885.
T. tricuspidata, Hansen, 1910.
T. tricuspidata, Hansen, 1912.
Cyrtopia rostrata, Dana, 1852.

Occurrence :

Stn. 2. fine silk net .	1 Cyrtopia.
,, 3. coarse silk net .	3 Furcilia 12.
1 m. stramin net	1 ,, 14.
,, 7, 1 m. ,, ,,	1 post-larval.
	2 Furcilia 14.
,, 8, coarse silk net .	1 post-larval.
	1 Cyrtopia.
	1 Furcilia 1.
	1 ,, 13.
,, 9, 1 m. stramin net	1 post-larval.
	1 Cyrtopia.
	1 Furcilia 14.
,, 10, coarse silk net .	1 ,, 1.
,, 11, 1 m. stramin net	1 ,, 14.
,, 12, 1 m. ,, ,,	1 ,, 10.
,, 13, coarse silk net .	1 post-larval.
	1 Furcilia 3.
	1 ,, 12
	1 ,, 13
Stn. 14, coarse silk net .	1 Furcilia 14.
,, 15, ,, ,, ,, .	1 post-larval.
	1 Cyrtopia.
	1 Furcilia 1.
,, 18, coarse silk net .	1 ,, 11.
	1 ,, 12.
	1 ,, 13.
,, 19, 1 m. stramin net	1 Cyrtopia.
1 m. silk net .	2 Furcilia 1.
coarse net . .	2 ,, 1.
	2 ,, 3.
	1 ,, 8.
	3 ,, 10.
	1 ,, 14.
,, 20, coarse net . .	1 ,, 8.
,, 21, 1 m. stramin net	1 ,, 14.

Remarks.—Sars (1885) has given a good description of the general course of larval development in this species, and there are only a few points that can be added to his account. He described and figured two Furcilia larvae, Nos. 1 and 4 of Lebour's nomenclature. In the present collection I have found Furcilia Nos. 1, 3, 8, 10, 11, 12, 13 and 14, so that at least nine Furcilia stages are known, and probably eleven occur in all.

The development of the pleopods in the Furcilla stages follows that which Lebour (1925) has worked out for *Nyctiphanes* and *Meganyctiphanes*. A stage in which three

pairs of simple pleopods are present is followed by one in which the first pair are setose and the following three pairs simple. The second pair become setose before the fifth pair are developed. A strong lateral spine is present on the lower margin of the carapace in all the Furcilia stages. The dorsal spine of the carapace makes its appearance at the last Furcilia stage. The dorsal spines of the third to the sixth abdominal somites can be detected in the first Furcilia stage. The spine on the sixth is clearly present then. Those of the other three somites are seen as minute acuminations of the posterior margins. The spines become successively more clearly marked with each moult, and by the time the last Furcilia stage is reached the abdomen has assumed the character of the adult.

Sars (1885, pl. xxxi, figs. 17–22) gives a series of figures showing the changes in the telson from the early Furcilia to the post-larval stage. It will be noticed that seven terminal spines are present on the posterior apical portion of the telson through all the stages. The median one gradually elongates with the apex of the telson and becomes the median apical spine, but even in the post-larval stage three spines are present on each side of the apical one. This is rather different from what occurs in most other Euphausians. The spines in the apical portion of the telson usually disappear quite early, except the median one, which always appears to form the acute apex of the telson. The present material confirms Sars's observations on this point.

None of the specimens from the Barrier Reef is completely adult. The largest two still have the eyes in the post-larval condition with the prominent lateral protuberance, having seven corneal lenses, as figured by Sars (1885, pl. xxxi, fig. 10).

The specimens were all taken between the months of July and October, 1928, and I have seen no specimens from the townettings taken between October, 1928, and July, 1929. It would therefore appear that the breeding season for the species is in the early spring of the southern year. Against this must be quoted the statement of Hansen (1910), who, from an examination of the Siboga material, concluded that *T. tricuspidata* in East Indian waters bred all the year round. It is possible, of course, that larval and young stages of this species occurred outside the Barrier Reef at other times of the year, and that the presence of young stages in the reef lagoon was due to an incursion of oceanic forms into the lagoon area during the period July to October, 1928.

2. *Thysanopoda orientalis*, Hansen ?.

T. orientalis, Hansen, 1910.

Occurrence.—Stn. 45, 1 m. stramin net, 1 young specimen, 15 m.

Remarks.—The specimen is not fully grown, as shown by the rostral plate, which is produced in front into a sharp, well-marked spine of quite considerable length. This is characteristic of the young of certain species of *Thysanopoda* (*e. g. T. orientalis* and *T. monacantha*), and the spiniform apex shortens and almost disappears in the adult stage. Otherwise the specimen agrees very closely with Hansen's description and figures of *T. orientalis* and I refer it provisionally to that species.

3. *Thysanopoda*, sp. ?.

Occurrence :

Stn. 12, 1 m. stramin net .	1 Cyrtopia.	Stn. 20, coarse silk net, 1 .	Furcilia 14.
,, 19, 1 m. silk net .	1 Furcilia 10.	,, 28, 1 m. stramin net .	1 late Cyrtopia.

Remarks.—I cannot refer these specimens to their adult species. All of them have a very large spine on the carapace near the posterior end of the lower margin, a well-marked dorsal organ and the eyes small and divided into two portions. They are in all probability young stages of *T. orientalis*.

Genus *Euphausia*, Dana.

4. *Euphausia mutica*, Hansen.

E. mutica, Hansen, 1910.

Occurrence.—Stn. 28, coarse net, 2 females and 1 male; 1 m. stramin net, 4 females and 2 males.

5. *Euphausia diomedeae*, Ortmann.

E. diomedeae, Ortmann, 1894.
E. diomedeae, Hansen, 1910.

Occurrence.—Stn. 28, coarse net, 1 female; 1 m. stramin net, 3 females and 1 male.

Remarks.—All these specimens appear to be the normal type, and not the variety with the inflated rostral plate as described for Ortmann's types.

6. *Euphausia tenera*, Hansen.

E. tenera, Hansen, 1910.

Occurrence:

Stn. 7,	1 m. stramin net .	3 adults.	Stn. 15,	coarse net . .	3 adults.
,, 8,	1 m. ,, ,, .	1 adult.	,, 16,	II 10 m. . .	3 ,,
	coarse net . .	1 Cyrtopia.		III 20 m. . .	2 ,,
,, 9,	,, ,, . .	1 adult.		IV 30 m. . .	2 ,,
,, 10,	1 m. stramin net .	1 ,,	,, 19,	coarse net . .	1 Cyrtopia.
,, 13,	1 m. ,, ,, .	1 Cyrtopia.		1 m. silk net .	2 Furcilia 14.
	coarse net . .	4 adults and			1 ,, 8.
		1 Cyrtopia.	,, 28,	1 m. stramin net .	4 adults.
,, 14,	1 m. stramin net .	2 adults.		coarse net . .	1 adult.
,, 15,	1 m. ,, ,, .	1 adult.			

Remarks.—This species is an oceanic form which lives in the upper waters and even at the surface. It invaded the waters inside the Barrier Reef in small numbers from August to October, 1928, but after that date no specimens occurred at the station near Low Island as long as weekly samples were taken.

7. *Euphausia pseudogibba*, Ortmann.

E. pseudogibba, Ortmann, 1893.
E. pseudogibba, Hansen, 1910.

Occurrence.—Stn. 28, coarse silk net, 1 male and 1 female.

Stn. 45, 1 m. stramin net, 1 female.

8. *Euphausia sibogae*, Hansen.

E. sibogae, Hansen, 1910.

Occurrence.—Stn. 50, 1 m. stramin net, 400–0 m., 1 male and 1 female.

Remarks.—These specimens differ from Hansen's description and figures in having the rostrum considerably longer. They are, however, not fully grown, and it is to this fact that I attribute the difference.

9. *Euphausia*, sp.

Occurrence.—Stn. 20, coarse net, 1 Calyptopis 3 ; 2 Furcilia 9.

Stn. 45, 1 m. stramin net, 1 Furcilia 14.

Remarks.—All these larvae, including the Calyptopis, have a lateral spine on the carapace. The Calyptopis closely resembles that described by Lebour (1926*b*) and Frost (1934), and attributed to *E. Krohnii.* It has a prominent, posterior dorsal spine on the carapace and the anterior edge of the carapace is serrate. The Furcilia 9 is a stage which Lebour believes to be characteristic of the genus *Euphausia*, with one pair of setose pleopöds and four pairs of simple ones. The Furcilia 14 has five spines at the apex of the telson between the usual large pair. It is not possible to refer these specimens to their adult species. From their close similarity to the larvae of *E. Krohnii* it may be suggested that they belong to the same group, and probably to *E. mutica.*

Genus *Pseudeuphausia*, Hansen.

10. *Pseudeuphausia latifrons* (G. O. Sars).

Euphausia latifrons, Sars, 1885.
Pseudeuphausia latifrons, Hansen, 1910.

Occurrence.—Weekly station at 3 mi. E. of Low Isles. Occurred at this station throughout the year and was captured on 34 occasions.

One mile N. of Low Island : Stn. 4, coarse silk closing net, 1 adult.

Reef Flat at high tide : 25.xi.28, 17 Calyptopis.

Other Stations.—Stn. 8, 45 m., 93 specimens, mainly Furcilia 13 and 14, and Cyrtopia.

Stn. 11, 61 m., 93 specimens from Calyptopis to adult.

Stn. 19, 225 m., 17 specimens, 10 adults and 7 Furcilia.

Stn. 26, 57 m., 2 adults and 1 Furcilia 2.

Off Cape Bedford.—Stn. 43, 30 m., 1 young specimen.

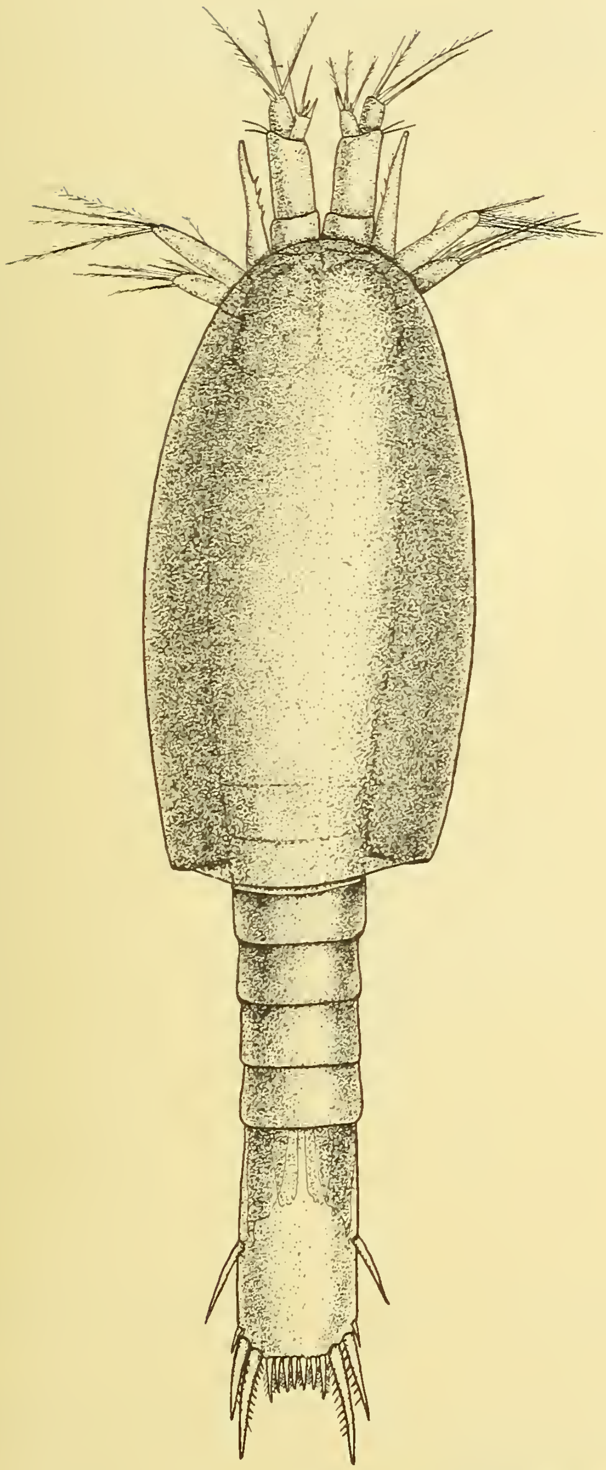
Inside Papuan Pass.—Stn. 49, 46 m., 1 adult, 15 Cyrtopia and 1 Furcilia 14.

Outside Papuan Pass.—Stn. 50, > 400, 1 m. stramin net, 170–0 m., 1 young specimen.

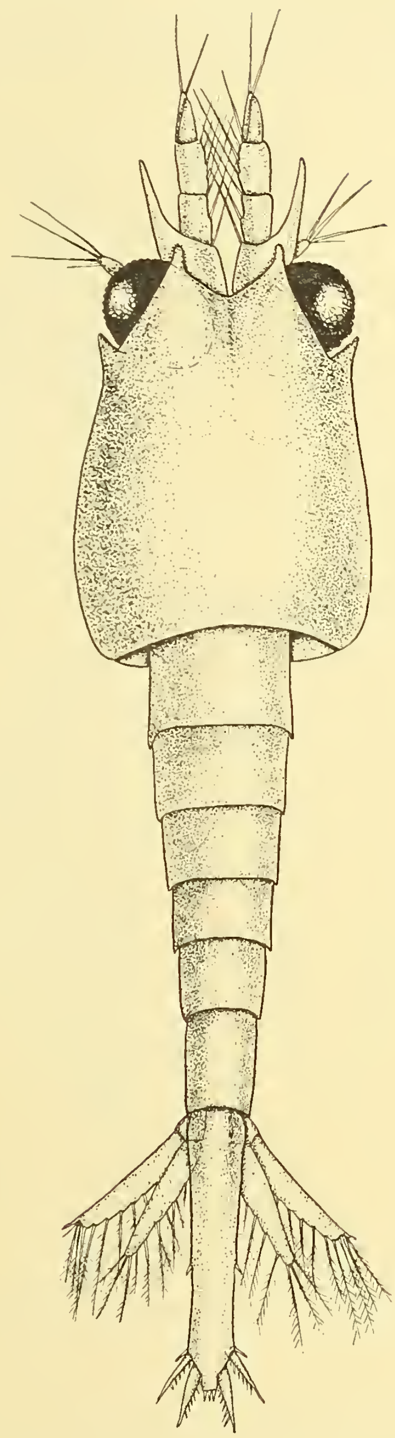
Remarks.—This is the dominant species inside the Barrier Reef, and, indeed, may be said to be the only species which is a regular inhabitant of the lagoon area all the year. Such other Euphausians as were taken inside the Barrier are oceanic species which occurred very sparingly from July to October.

All stages in the development occurred from the first Calyptopis to the adult. The breeding season lasts from July to the end of November, with a maximum occurring in the first week of October. After the end of November only late Furcilia (stages 13 and 14), Cyrtopia and adults were found in the nets. On the other hand, ovigerous females occurred in November, 1928, and in March, 1929.

Text-fig. 10.



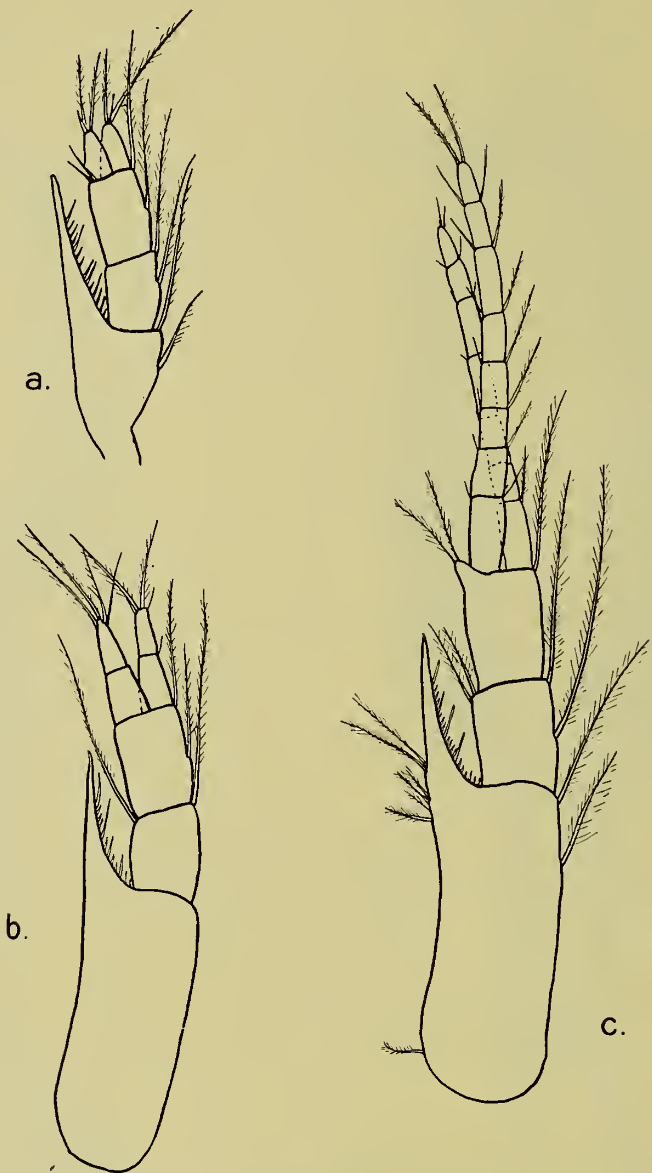
Text-fig. 11.



Text-fig. 10.—Third Calyptopis larva of *Pseudeuphausia latifrons* (G. O. Sars). × 120.

Text-fig. 11.—Furcilia 8 of *Pseudeuphausia latifrons* (G. O. Sars). × 60.

Adult specimens agree with Hansen's re-description (1910) of this species in possessing a lateral denticle on the carapace, and in the form of the antennules. On the latter point Hansen confirms my earlier observations and figures of these appendages (1906). In one respect these specimens differ from Hansen's description and agree with that of Sars.



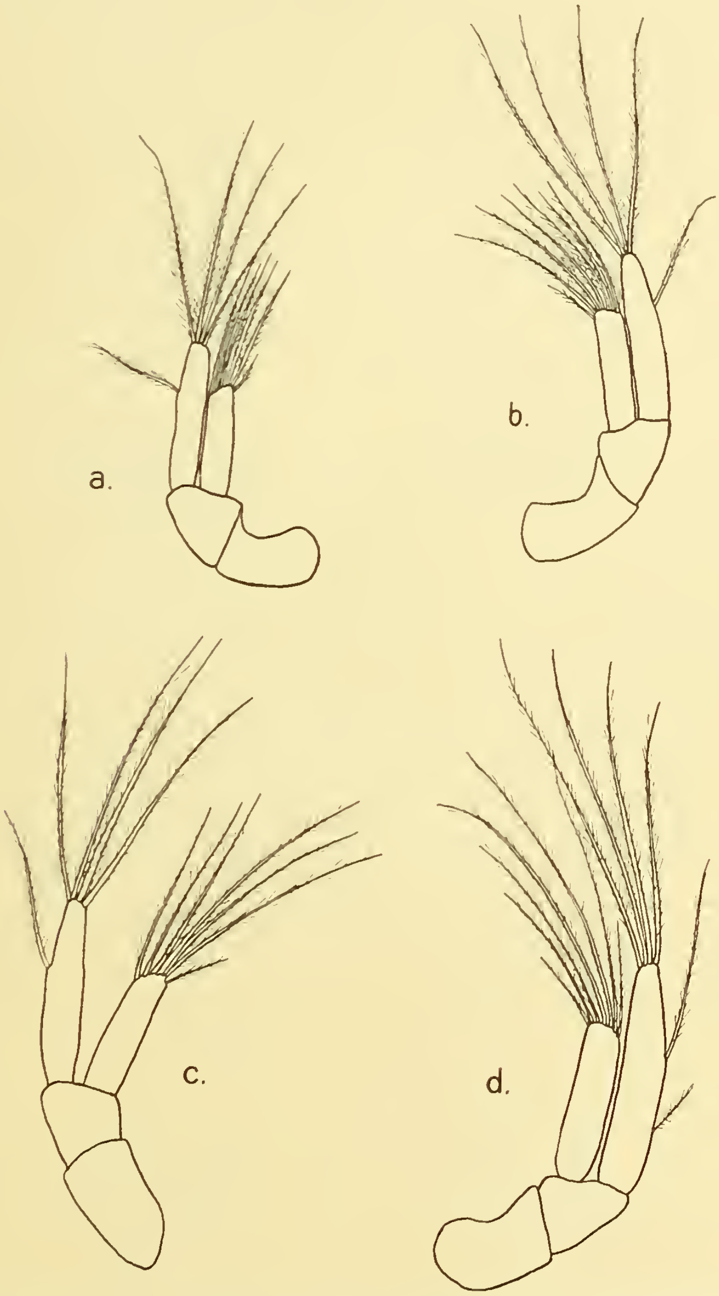
TEXT-FIG. 12.—Development of the antennules in the Furcilia larvæ of *Pseudeuphausia latifrons* (G. O. Sars). *a*, Furcilia 1; *b*, furcilia 4; *c*, furcilia 14. All × 120.

They possess a short but distinct spine on the posterior median dorsal border of the sixth abdominal somite overhanging the base of the telson.

Hansen says " the abdomen without dorsal spines ", thereby implying that this spine was not present in his specimens. Hansen has also described the ovisacs of the female. I can confirm his observations. The egg-sacs strongly recall those of *Nyctiphanes*, but appear to differ in that the distal anterior extremities of the ovisacs of each

side fuse, so that the sacs appear as a single sac with a rounded anterior end and a deeply divided posterior end.

Calyptopis larvae (Text-fig. 10).—Three Calyptopis stages were observed corresponding to the three stages regarded by Lebour as normal to all Euphausians. The Calyptopis

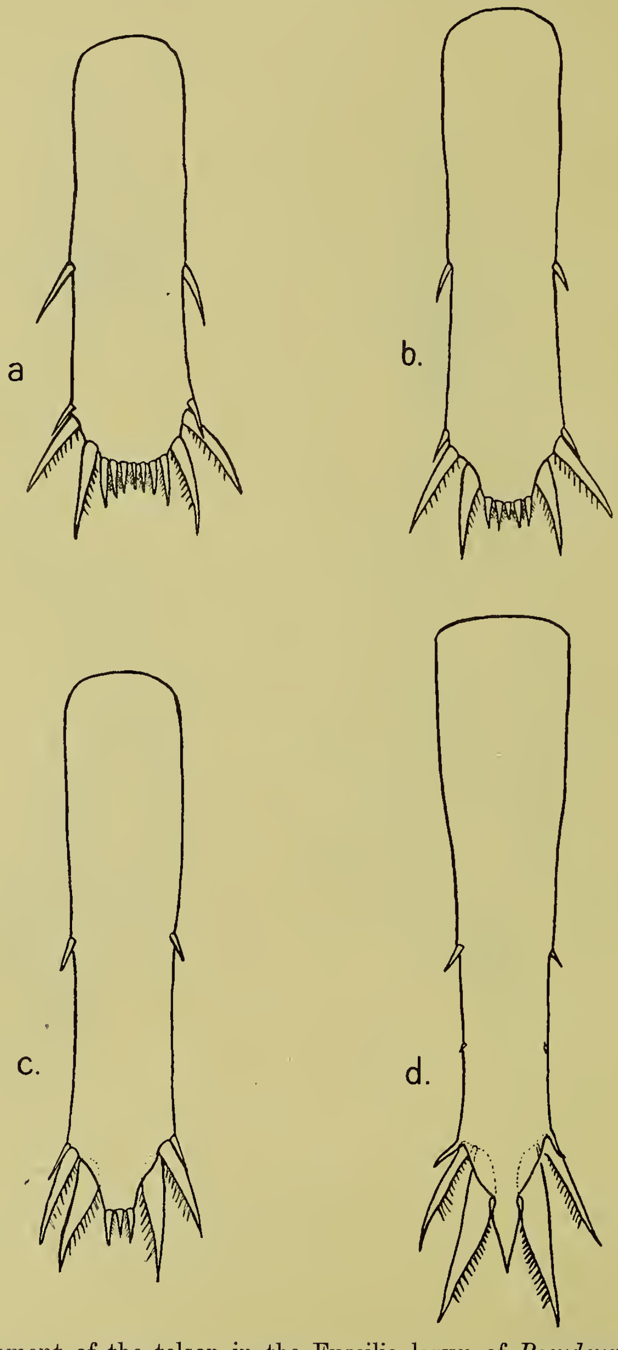


TEXT-FIG. 13.—Development of the antennæ in the Furcilia larvæ of *Pseudeuphausia latifrons* (G. O. Sars). *a*, Furcilia 1 ; *b*, furcilia 4 ; *c*, furcilia 8 ; *d*, furcilia 14. All × 120.

larva has the carapace ovoid in shape, with an evenly-arched and perfectly smooth anterior margin, without any serrations. There is no posterior, median, dorsal spine on the carapace. In all the Calyptopis stages the lateral margin of the carapace is without a lateral denticle. The first Calyptopis stage has six spines at the apex of the telson between

the long terminal, lateral spines. The second and third stages have seven spines in this position.

The Calyptopis of *P. latifrons* is strongly reminiscent of the same stage in *Nyctiphanes* and *Meganyctiphanes*, especially in the robust form of the body, the smooth anterior



Text-fig. 14.—Development of the telson in the Furcilia larvæ of *Pseudeuphausia latifrons* (G. O. Sars). *a*, Furcilia 1 ; *b*, furcilia 4 ; *c*, furcilia 8 ; *d*, furcilia 14. All × 120.

margin of the carapace and the absence of a posterior dorsal spine. The Calyptopis stage of the genus *Euphausia* appears to show considerable variation. In the *E. Krohnii* group the front margin of the carapace is serrated and the posterior median dorsal margin is prolonged into a short spine. This spine is also present in the Calyptopis of

E. triacantha (Rustard, 1934), and is indicated at least in the third Calyptopis of *E. frigida* (Rustad, 1930), though neither of these species has a serrated anterior margin to the carapace.

Furcilia stages.—Using Lebour's scheme and numbering of the Furcilia stages (1926*a*, p. 523) the following Furcilia stages of *P. latifrons* have been found in the material from the Barrier Reef, having the development of the pleopods ascribed to these stages by Lebour—Nos. 1, 2, 3, 4, 8, 10, 12, 13 and 14. In addition there occurred a stage, which might be called 10*a*, in which there are three setose pairs of pleopods, one pair non-setose and the last pair as yet undeveloped. This stage appears to take the place of Lebour's stage 11 in the life-history of *P. latifrons*. In all there are thus ten Furcilia stages in this species.

A few Furcilia occurred which could not be placed in any of the above stages. There was one in which the pleopod formula was S_1 N_1 0 0 0, another with the formula S_1 N_2 0 0, and a third type with the formula S_2 N_1 0 0. These abnormal forms were very few. They all had three spines at the apex of the telson and I regard them as variations of Furcilia 8.

The general form of the Furcilia is shown in Text-fig. 11. Its most characteristic feature is the form of the rostral plate, deeply emarginate, with prominent lateral spines. The rostral plate has a distinct median depression, and the sides of the rostrum rise from this groove so that the emargination is angular in the centre. This is substantially the form of the rostral plate of the adult, the principal change being merely the gradual disappearance of the emargination so that in the adult the front edge of the plate is nearly or quite straight. The rostral plate serves to distinguish both the Furcilia and the Cyrtopia stages of *P. latifrons* from all other Euphausian larvae described hitherto. The carapace bears a small lateral denticle, which makes its appearance in the first Furcilia stage, and persists right through the larval stages to the adult condition.

The following table gives the size of the stages and the number of spines at the apex of the telson, between the large lateral spines, showing the gradual reduction in number from seven in the first stage to one in the last :

Stage.	Length in mm.	Spines at apex of telson.
1	2·0	7 (one or two with 5 spines).
2	2·2	5
3	2·4	5
4	2·4	5 (one with 7).
8	2·5	3
10	2·6	3
10a	2·8	3 (one with only 1).
12	2·8	1 (one with 3).
13	3·0	1
14	3·4	1

From this table it will be seen that there is a certain amount of individual variation in the number of spines on the apex of the telson. The telson develops quickly, and by the end of the Furcilia stages has assumed, practically, the adult form. A similar rapid development of the telson was found by Lebour (1926) to occur in *Thysanopoda æqualis*.

Cyrtopia stages.—These stages call for no special comment. They can be recognized at all stages by the form of the rostral plate.

The life-history of *P. latifrons*, as deduced from the larvae here described, is characterized by a prolonged larval life. No fewer than ten Furcilia stages were detected in the material. In contrast to this both Lebour (1926) and Frost (1934) have only been able to find three Furcilia stages in *Euphausia Krohnii,* corresponding to stages 2, 9 and 14 of Lebour's nomenclature. Frost suggests that deep-sea forms have abbreviated life-histories in which several Furcilia stages have been omitted. It is at least interesting that *Nyctiphanes* and *Pseudeuphausia,* both of which have apparently a prolonged larva life, are shallow-water genera.

The life-history of *P. latifrons* lends support to the separation of this species from the genus *Euphausia* which Hansen made on morphological grounds. In fact, the life-history seems to me to suggest that *Pseudeuphausia* is more nearly related to *Nyctiphanes* than to *Euphausia.*

Genus *Nematoscelis,* G. O. Sars.

11. *Nematoscelis microps,* G. O. Sars.

N. microps, G. O. Sars, 1885.
N. microps, Hansen, 1910.

OCCURRENCE :

Stn. 8, 1 m. stramin net .	1 specimen.	Stn. 19 (*cont.*), coarse net.	1 specimen.
coarse net .	2 specimens.	,, 20 ,, ,, .	1 ,,
,, 13, 1 m. stramin net .	1 specimen.	,, 28, 1 m. stramin net .	1 ,,
,, 19, 1 m. ,, ,, .	3 specimens.	,, 45, 1 m. ,, ,, .	1 ,,
1 m. silk net .	2 ,,		

REMARKS.—Of the specimens 8 are adult, 4 in the late Cyrtopia stage and 1 in the Furcilia stage 13. Only 1 specimen, that from Stn. 13, was taken inside the Reef. All the others were captured in oceanic waters on the edge of the Reef.

Genus *Stylocheiron,* G. O. Sars.

12. *Stylocheiron carinatum,* G. O. Sars.

S. carinatum, G. O. Sars, 1885.
S. carinatum, Hansen, 1910.

OCCURRENCE :

Stn. 12, coarse silk net .	1 adult.	Stn. 19, 40 m. (*cont.*) .	2 late Furcilia.
,, 16, 40 m. . . .	1 late Furcilia.		1 Furcilia 2.
,, 19, 40 m. . . .	6 adult.	,, 20, coarse net .	2 adults.
	7 Cyrtopia.		

REMARKS.—The first two occurrences are from within the Barrier Reef, and the other two from the oceanic waters at the edge of the Reef.

13. *Stylocheiron affine*, Hansen.

S. affine, Hansen, 1910.

Occurrence.—Stn. 20, coarse net, 1 ovigerous female carrying eggs, 1 Furcilia 4.

Remarks.—The fourth Furcilia of this species differs from the ninth of *S. suhmi* in being larger in size, in having five cones in the distal part of the eye and in having seven spines on the apex of the telson.

14. *Stylocheiron suhmi*, G. O. Sars.

S. suhmi, Sars, 1885.
S. suhmi, Hansen, 1912.

Occurrence :

Stn. 19, 1 m. stramin net .	5 specimens.	Stn. 28, coarse net .	2 specimens.
,, 20, coarse net . . .	4 ,,	,, 50, 1 m. stramin net (170–0 m.)	2 ,,

Remarks.—These specimens are mostly young adults. There is one Furcilia 9 which agrees with Lebour's description. It has 6 spines on the apex of the telson, and is shorter than the Furcilia 4 of *S. affine*. Of these specimens some have two and others have three cones in the distal portion of the eye.

15. *Stylocheiron elongatum*, G. O. Sars.

S. elongatum, Sars, 1885.

Occurence.—Stn. 50, 1 m. stramin net, 400–0 m., 1 adult.

16. *Stylocheiron abbreviatum*, G. O. Sars.

S. abbreviatum, Sars, 1885.
S. abbreviatum, Hansen, 1910.

Occurrence.—Stn. 19, 1 m. silk net, 2 Furcilia 2, 1 Cyrtopia.
Stn. 20, coarse net, 1 Furcilia 14.
Stn. 50, 1 m. stramin net, 170–0 m., 1 adult.

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SCIENTIFIC REPORTS

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CERIANTHARIA AND ZOANTHARIA

BY

OSKAR CARLGREN

Professor Emeritus, Zool. Inst. Lund, Sweden

WITH THIRTY-FOUR TEXT-FIGURES AND ONE PLATE

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CERIANTHARIA

The Ceriantharia taken by the Great Barrier Reef Expedition were only two, the one a new species of the genus *Arachnanthus*, the other a new, small larva, which I have with some hesitation referred to the genus *Anthoactis* Leloup.

Arachnanthus australiae n. sp.

Diagnosis.—A small species. Marginal and labial tentacles rather short, not numerous. Arrangement of the tentacles as in *Arachnanthus bocki* Carlgr. Directive labial tentacle absent. Actinopharynx rather long. In the lower part 6–8 mesenteries, in the upper 12 attached to the broad siphonoglyph, which does not reach up to the oral end of the actinopharynx. Hyposulcus about half as long as the actinopharynx. Directive mesenteries reaching to the aboral part of the hyposulcus. Second protomesenteries (P_2) without plecto- and telocraspedon, sterile, their free parts about of the same length as the actinopharynx. P_3, B- and b-mesenteries with short orthocraspedon and long plectocraspedon, their free parts about as long as the hyposulcus. M- and m-mesenteries diminishing in length towards the multiplication chamber, the oldest almost reaching to the aboral pole, with very long orthocraspedon and short telocraspedon. Two or three of the oldest M- and m-mesenteries with an acontioid. Structure of the orthocraspedon on P_2, M and B that of Type 1. Telocraspedons broad with a deep longitudinal furrow. Acontioids similar to those of other species of *Arachnanthus* with strong muscles. Endoderm of P_2 and M-mesenteries with very numerous curved nematocysts, which in B-mesenteries are more sparse.

Colour in formalin.—Column yellowish, marginal tentacles on their insides with up to 6 yellowish cross-bands, at the base between the tentacles red-brown stripes, sometimes continued on the oral disc, inside of the labial tentacles red-brown. Nine tentacles around the directive chamber uncoloured ; at the base of the labial tentacles at the

insertions of the mesenteries red-brown stripes; uppermost part of the actinopharynx yellowish, largest part of it and the siphonoglyph uncoloured.

Dimensions.—Length of the body 7·5 cm., greatest breadth 0·7 cm., length of the marginal tentacles 0·7 cm., that of the inner 0·15 cm.

Text-fig. 1.

Text-fig. 3.

Text-fig. 2.

Text-fig. 1.—*Arachnanthus australiae* n. sp. Diagram of the arrangement of the older mesenteries. Thick lines, orthocraspedons; folded parts, plectocraspedons, siphonoglyph and hyposulcus dotted. *a*. Acontioids. See text.

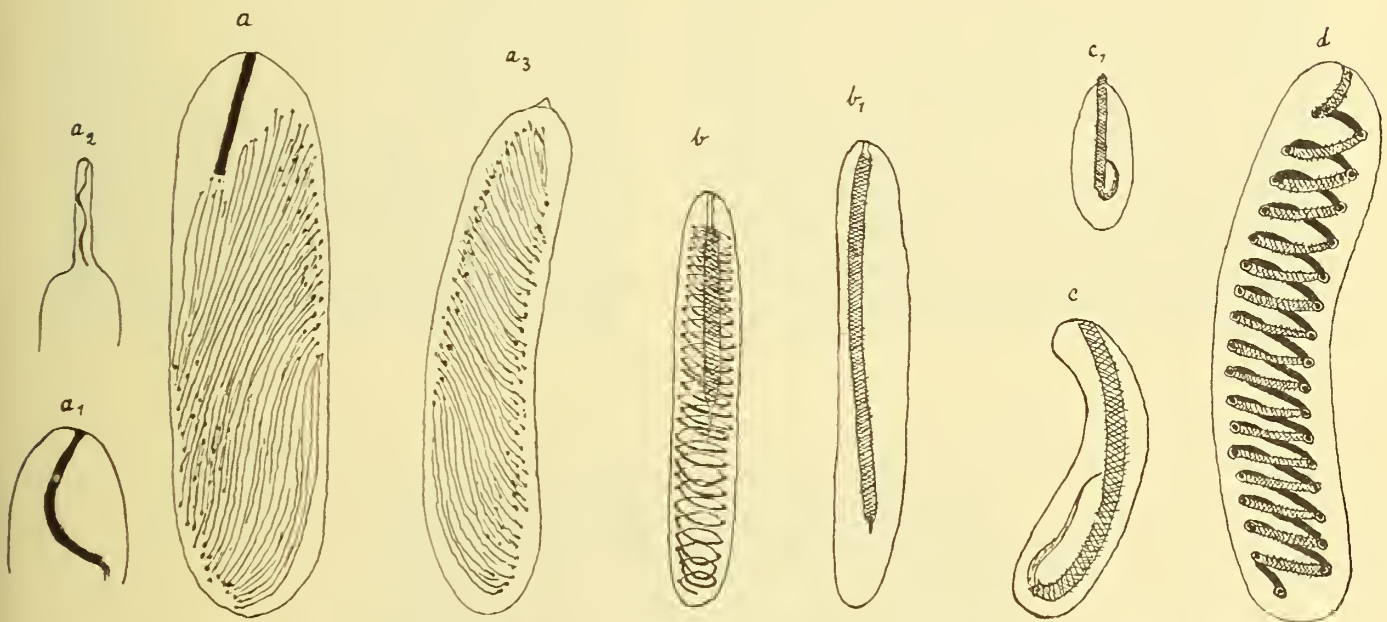
Text-figs. 2, 3.—*Arachnanthus australiae* n. sp. Tranverse section of an orthocraspedon (fig. 2) and of a telocraspedon (fig. 3) of the first metamesentery (M_1).

Occurrence.—General survey, Low Isles: 1 specimen.

The species has the same general structure as other species of *Arachnanthus*. The marginal and labial tentacles were arranged in a single cycle. The labial tentacles were 35 in number; a directive labial tentacle was absent. The actinopharynx was rather

long, the siphonoglyph broad, the hyposulcus long but considerably shorter than the actinopharynx, the hemisulci absent. In the lower part 6, possibly 8 mesenteries were attached to the siphonoglyph, in the upper part 12. The cilia of the siphonoglyph were twice as long as those of the actinopharynx. The arrangement and structure of the mesenteries I have described in the diagnosis. Certainly there was no plectocraspedon and probably no telocraspedon on the second protomesenteries (P_2). It was difficult to decide whether a telocraspedon was present or absent here, as the aboral end of P_2 was strongly convoluted; if present, the telocraspedon may have been very short.

I have given a diagram of the oldest mesenteries and of the actinopharynx in Text-fig. 1. As in the collection only a single specimen was present, which I did not want to



TEXT-FIG. 4.—*Arachnanthus australiae* n. sp. Nematocysts. c, c_1 from the cnidoglandular tract of the filaments; all the others from the ectoderm of the column. All nematocysts at the same magnification. See text.

destroy too much, I have marked the boundary between the orthocraspedon and the telocraspedon only on the left metamesenteries M and m; on the other M- and m-mesenteries the ortho- and telocraspedons are not marked. Text-figs. 2 and 3 show the structure of the orthocraspedon and the telocraspedon. The ascending and descending limbs were distinct in the acontioids, but their gland-cells were macerated. There is, however, no doubt that the acontioids were of the same structure as in other species of *Arachnanthus*.

I have examined the cnidæ in maceration preparations in different parts of the animal. There were, however, no capsules wholly exploded. I think, nevertheless, that it is possible apart from the capsules c, c_1 (Text-fig. 4) to determine their structure. The cnidæ of the column were very numerous and of different kinds: (A) Atrichous cnidæ (Weill), (1) large and broad, 42–50 × 12–14μ, numerous; (2) large but narrower, 42–52 × 7 (8·5) μ (Text-fig. 4, a_3), numerous; (3) small, 19–23 × 5–6μ. In the figure a and a_1 it seems as if the thread should be provided with a handle (a differentiated, thickened part of the thread), but this is not the case, as we see in the figure a_2, where the thread is

ejected a little. (B) Probably microbasic mastigophors (Weill), either with the handle about half as long as the capsules (Text-fig. 4*b*) or longer (Text-fig. 4b_1), 33–39 × about 5μ. (C) Cnidæ of the type *c*, c_1, often curved, 41–48 × 5–6·5μ, sparse. (D) Very rare, as I think holotrichous cnidæ (Weill), 43–55 × 11–12μ (Text-fig. 4*d*). As far as I can see the thread had barbs; the capsules were stained with methylene-blue in contrast with the spirocysts. (E) Spirocysts 19–20 × 2μ, rather few. In the ectoderm of the tentacles there were numerous spirocysts up to about 36 × 6μ ; atrichous cnidæ 35–41 × 6–8·5μ, sparse; microbasic mastigophors about 31 × 5μ, sparse; and nematocysts of the type *c*, often curved, 37–44 × 7–9μ. The ectoderm of the actinopharynx had atrichous cnidæ 29–41 × 5–7μ ; microbasic mastigophors 29–36 × 5–6μ, and cnidæ of the type *c*, 41–46 × 7–10μ. In the middle tract of the filaments spirocysts occur; in the cnido-glandular tract there were microbasic mastigophors, 30–32 × 5·5–6μ, and cnidæ of the type *c*, partly smaller, 16·5–19 × 3·5–5μ, partly larger, 38–46 × 7–10μ. Outside the filaments the *c*-capsules were very numerous in the endoderm. In the ectoderm of the tentacles and actinopharynx I have exceptionally observed small capsules, possibly of the type *b*, measuring 16–19 × almost 2·5μ. The species is not identical with *Cerianthus nobilis* Hadd. & Shackl. from Warrior and Thursday Islands, Torres Strait and Port Darwin.

Anthoactis australiae n. sp.

Diagnosis.—Body obconical; marginal tentacles short but thick (owing to contraction ?); labial tentacles forming only low protuberances, probably arranged 1, 1, 1, I, 1, 1, 1; directive labial tentacle certainly absent. Actinopharynx furrowed at the insertions of the mesenteries. Siphonoglyph (sulcus) little differentiated with longer cilia than the other parts of the actinopharynx, without nematocysts; hyposulcus practically absent; hemisulci long. Mesenteries 11, most of them strongly vacuolated. Directive mesenteries short, P_2 the longest mesenteries, with long orthocraspedon and well developed plectocraspedon; P_3 with short orthocraspedon but long plectocraspedon, somewhat longer than the directives; M_1 with orthocraspedon and probably telocraspedon but no plectocraspedon; B_1 as P_3 but considerably shorter. Ciliated tracts of type 3. Mesenterets on all stronger mesenteries.

Colour.—Unknown.

Size.—Height and breadth 0·2 cm.

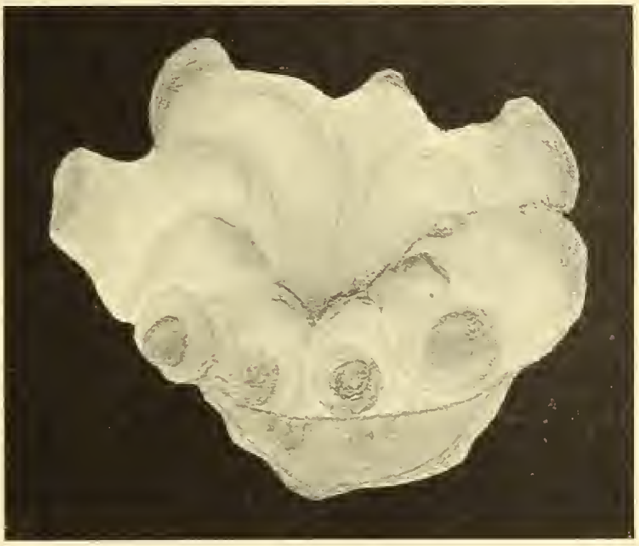
Occurrence.—3 miles off Low Isles, coarse silk townet, 1 specimen.

The figures 5–7 show the larva from different sides. Of the 9 marginal tentacles, 4 on each side of the directive tentacle, were short and thick, the youngest left smallest. Their facies was certainly somewhat altered owing to contraction. When beginning my examination of the specimen I could not decide whether the elevations of the oral disc were rudimentary labial tentacles or not, but after making cross-sections of the whole animal I think that they probably are. If so the species is not an *Isodactylactis* Carlgr., but must be referred to the genus *Anthoactis* proposed by Leloup (1932), though there possibly may be some differences as to the filaments of the first metamesenteries. In my species it seems as if there were no plectocraspedon present, but it is very difficult to decide that with certainty, as the filaments and the epithelia were on the whole not well preserved.

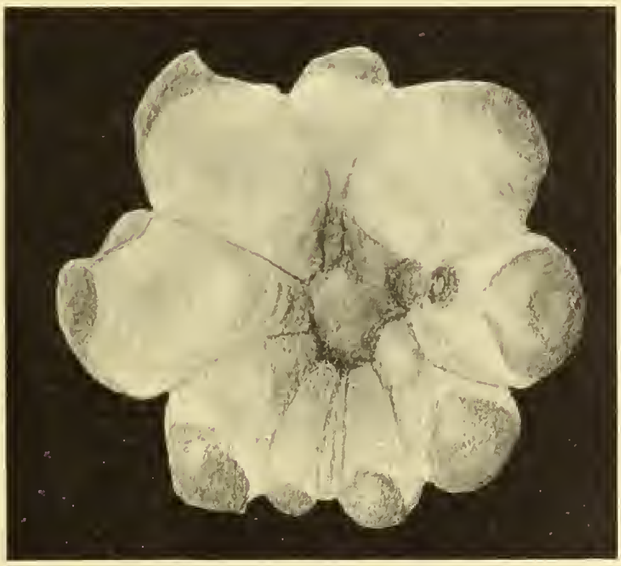
Leloup's diagram of both his species seems to show that the first metamesenteries are provided with plectocraspedons. In every case no directive labial tentacle is present in

TEXT-FIG. 5.

TEXT-FIG. 6.



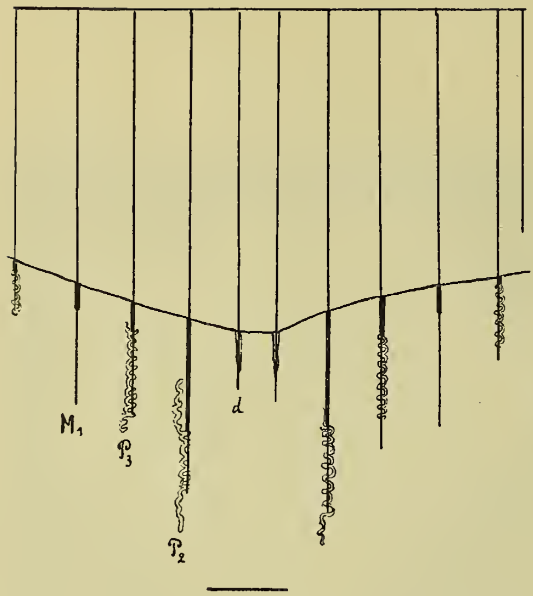
TEXT-FIG. 7.



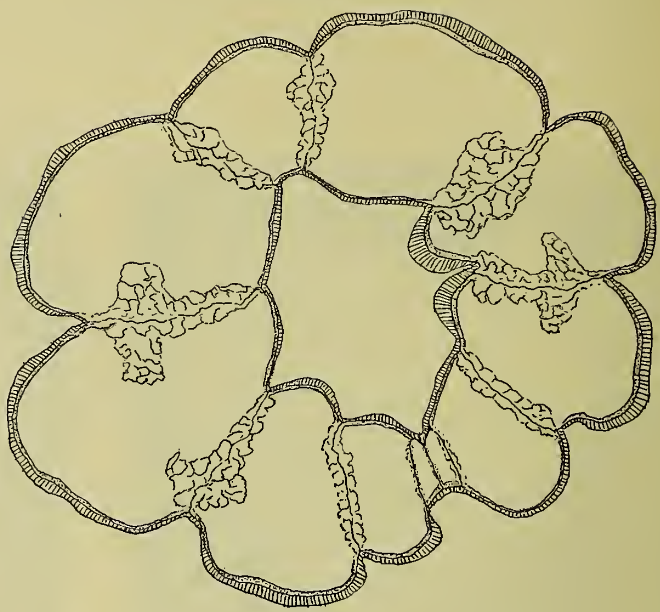
TEXT-FIGS. 5–7.—*Anthoactis australiae* n. sp.

australiae. I have given a diagram of the mesenteries in Text-fig. 8, and figured a section of the 11 mesenteries present in the region of the upper part of the actinopharynx (Text-fig. 9) on the right hand. Where the ectoderm is thickened, two labial tentacles have, however, been cut, because the section is somewhat oblique. Text-fig. 10 represents a section of the right third protomesentery in the region of the cnidoglandular tract.

Text-fig. 8.



Text-fig. 9.



Text-fig. 10.

Text-fig. 8.—*Anthoactis australiae* n. sp. Diagram of the arrangement of the mesenteries. Thick lines, orthocraspedons; folded parts, plectocraspedons. *d*. Directives.

Text-fig. 9.—*Anthoactis australiae*. Transverse section of the body in the region of the actinopharynx.

Text-fig. 10.—*Anthoactis australiae* n. sp. Transverse section of the third, right protomesentery (P_3).

ZOANTHARIA

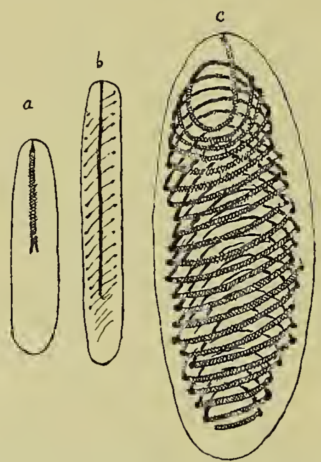
Everyone examining the Zoantharia has learnt how difficult it is to determine the members of this group of Anthozoa. It is true that at present the species can be referred to the right genus at least by an anatomical examination, but it is more difficult to decide if a specimen belongs to a species already described or if it is new to science. It is clear that a species, the description of which is old and based only on external characters, is generally very difficult to identify, because many forms of Zoantharia look like each other superficially, and only when the holotype is available for examination or one can get specimens from the place from which the holotype was described is the identification of the species sure or almost sure. But certain anatomical characters such as those given by Haddon and Shackleton, 1891, the first authors to have used extensively the anatomy of Zoantharia for systematic purposes, are generally not sufficient to identify a species. For purposes of classification further anatomical details are necessary. Thus, as I have already shown (1912), a species cannot be diagnosed without knowledge of the size and distribution of the cnidae. This has been confirmed in a paper of Siefert (1928), who examined the cnidæ of some genera not investigated by me.

As far as I can see Seifert has mostly measured the cnidæ on slides. I think that such measurement gives too low values, because the cnidæ seem to shrivel a little during treatment, and it is more difficult to make an exact measurement on slides than in maceration preparations. As to the filaments it is, however, necessary to complete the examination on slides, because it is not easy to isolate the filaments from the other parts of the mesenteries, where cnidæ often occur. As to the distribution of the cnidæ Seifert has distinguished three groups of *Zoanthus* as well as of *Palythoa*. There is no doubt that these genera can be arranged in more groups, as we see from the descriptions here given.

Seifert distinguished among the Zoantharia three categories of cnidæ: spirocnidæ (new name for spirocysts), gyrocnidæ (or macrocnidæ, if the gyrocnidæ are large), and craspedocnidæ. Weill (1934, p. 92) is of the opinion that this classification is " encore moins utilisable que la précédente "—the division of certain capsules into penicilli and spirulæ). True that Seifert has made several mistakes as to the base of the thread partly owing to his examination of the cnidæ on slides. His classification was, however, an attempt to systematize the cnidæ of the Zoantharia. But it is not difficult to identify Seifert's gyrocnidæ and macrocnidæ with Weill's holotrichs, and his craspedocnidæ with microbasic mastigophors (compare Text-fig. 11 *c* and *b*). Unfortunately the cnidæ of Zoantharia seldom are exploded in preserved material, so that it is sometimes difficult to decide to which type a nematocyst belongs. Although I myself have seen the present nematocysts only in an unexploded state, I can state here that the type *b* (Text-fig. 11) is a microbasic mastigophor. As to the type *a*, it is difficult to determine if it is a microbasic mastigophor or an amastigophor. It is possibly the former, but I prefer to leave this question unanswered for the moment. Thus it is certain that in the Zoantharia at least three types of cnidæ occur. Weill has observed only two in *Zoanthus proteus*, but this is certainly wrong. If he had examined the filaments, he would without doubt have found mastigophors. I hope to have occasion to discuss Weill's division of the nematocysts of the Anthozoa in another paper.

I have here for the first time given figures of the canal system of the column from surface-preparations of three *Zoanthus*-species, as also figures of the canals in the lower part of the mesenteries of several species of *Palythoa.* Although certainly rather large variations in the appearance of the canal system occur in a species—in some species probably more than in others—it seems to me that the canal system too can be of use when we diagnose a species. But in order to get as good an idea as possible of the typical appearance, it is necessary to make preparations of more than one specimen of a species. In the present paper I have also examined the macrocnidæ (holotrichs) in the mesenterial canals, where these cnidæ are as a rule larger than in other parts of the body.

For comparison especially of the cnidæ I have examined *Zoanthus coppingeri* and *jukesii,* as also *Palythoa kochii, cæsia, howesii* and (*Gemmaria*) *mutuki* described by Haddon



Text-fig. 11.—Nematocysts of *Palythoa projecta* n. sp. (*a*, *c*) and of *Palythoa howesii* (*b*). (*a*) From the filament ; (*b*) microbasic mastigophor from the ectoderm of the coenenchyme ; (*c*) holotrich from a mesenterial canal.

and Shackleton (1891) from Torres Strait. I beg to express my thanks to the directorate of the British Museum for the loan of the species. Before I go over to the description of the species taken by the Great Barrier Reef Expedition I will give some notes on the *Zoanthus*-species described by these authors.

Zoanthus coppingeri Hadd. & Shackl.

Of these species I have examined one specimen having a bud near its base. I have sectioned the uppermost part of the polyp, and can corroborate the observations made by Haddon and Shackleton as to the extraordinarily rich development of the canal system in the mesogloea of the column. In surface preparations at the level of the actinopharynx one can see that there are two nets of canals situated in two different planes but communicating with each other, one with thicker canals lying more superficially, and one with thinner canals situated more deeply in the mesogloea. The first is certainly the one communicating with the ectoderm ; the latter has very coarse knots in the rather close meshes.

As to the sphincter I do not understand the terms " upper " and " lower " sphincter in the paper of Haddon and Shackleton (1891), though the terms are distinctly explained in a

later paper of Haddon and Duerden (1896), where in *Z. shackletoni* the authors talk of a proximal or lower sphincter, which is well developed, and of a distal or upper portion being much smaller—this statement agreeing with the figure. In the paper of 1891 Haddon and Shackleton say of *Zoanthus coppingeri*—" the upper portion [of the sphincter] being slightly shorter than the lower one ", and of *Zoanthus macgillivrayi*, " the upper [sphincter] being the longer of the two parts ". Comparing these statements with figs. 3 and 5, Pl. 67, of the sphincters of both specimens, it seems as if both sphincters should be of about the same size ; if there is any difference, to judge from the figures the upper sphincter of *Z. coppingeri* is somewhat stronger than the lower one, whereas in *Z. macgillivrayi* it is weaker. Thus I think that Haddon and Shackleton have wrongly named that part of the sphincter, which in an invaginated state of the polyps is uppermost, the upper ; it is in fact the lower or proximal sphincter. This supposition has been confirmed by an examination of the sphincters of *Zoanthus jukesii*. True that the distal sphincter was not well preserved, but there is no doubt that it is much weaker than the rather strong proximal sphincter. Haddon and Shackleton state that the upper sphincter is the longer.

The specimen examined had 52 mesenteries.

The holotrichs of the ectoderm of the column were 17–23 × 6–7μ long and rather common ; those of the tentacles 18–24 × 6–6·5μ ; those of the actinopharynx 20–24 × 6–7μ ; those of the filaments 22–24 × 6·5–7μ, few ; the microbasic mastigophors in the ectoderm of the actinopharynx 14–22 × 2·5 to almost 3μ ; those of the filaments 22–24 × 6·5–7μ ; nematocysts of the type *a* in the ectoderm of the actinopharynx about 17 × 4·5–5μ ; in the filaments 15–18 × 4·5–5μ ; spirocysts of the tentacles 17–29 × about 2–4μ, numerous.

Zoanthus jukesii Hadd. & Shackl.

The holotrichs of the ectoderm of the column were 14–17 × 5–6μ long, numerous ; those of the tentacles 13–17 × 5·5–6·5μ, very common ; those of the actinopharynx 13–17 × 5–6μ, not so numerous ; those of the filaments 14–17 × 5–6μ ; the microbasic mastigophors in the ectoderm of the actinopharynx were 19–24 × 2·5–3·5μ, few ; those of the filaments 30–35 × 4·5–5μ. I have not found any spirocysts in the maceration preparations of the tentacles.

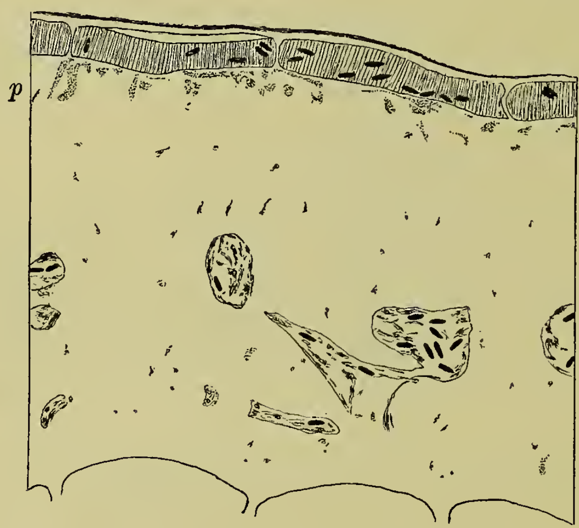
As to the sphincter, compare *Z. coppingeri.*

None of the *Zoanthus*-species described below is identical with Haddon's and Shackleton's species, or with *Zoanthus* (*Acrozoanthus*) *australiae* Saville-Kent, which is associated with a tubicolous annelid, and according to Haddon (1898, p. 404) has a very strong distal sphincter, stronger than the proximal one.

Zoanthus anneae n. sp.

Diagnosis.—Small cylindrical polyps, not closely packed together, and connected with each other by a rather thick coenenchyme forming now a flattened disc, now broad or more seldom thin stolons. Ectoderm of the scapus discontinuous, with numerous holotrichs but without zooxanthellae. Mesogloea of the column rather thick with numerous, pigmented, irregular cells mostly situated close to the ectoderm, with thicker and thinner canals forming an irregular network. In the mesogloea, moreover, scattered

small cells. Canals with holotrichs but without zooxanthellae. Ectoderm of the tentacles without zooxanthellae but with very numerous spirocnidae. On the outside of the tentacles close-packed holotrichs. The distal (upper) sphincter rather weak, the proximal sphincter very strong, long and occupying almost the whole mesogloea. Actinopharynx longitudinally furrowed, the siphonoglyph only a little differentiated. Mesenteries 46–54, micromesenteries well developed. Endoderm with numerous zooxanthellae. Holotrichs of the column 13–18 × 4·5–5·5μ long, numerous; those of the tentacles 13–17 × 5–5·5μ; those of the actinopharynx 13–17 × 5–6μ; those of the filaments (14) 17–19 × 5·5–6μ; those of the mesenterial canals 14–17 × 5–6μ. Nematocysts of the type *a* (Text-fig. 11) (14) 17–22 × 4·5–5·5μ, numerous; spirocysts of the tentacles very numerous, 12 × 2–18 × 3μ.



TEXT-FIG. 12.—*Zoanthus anneae* n. sp. Transverse section of the scapus. *p*. Pigmented cells close to the ectoderm. The holotrichous cnidae in the ectoderm and canals black. In the mesogloea are cells and pieces of canals.

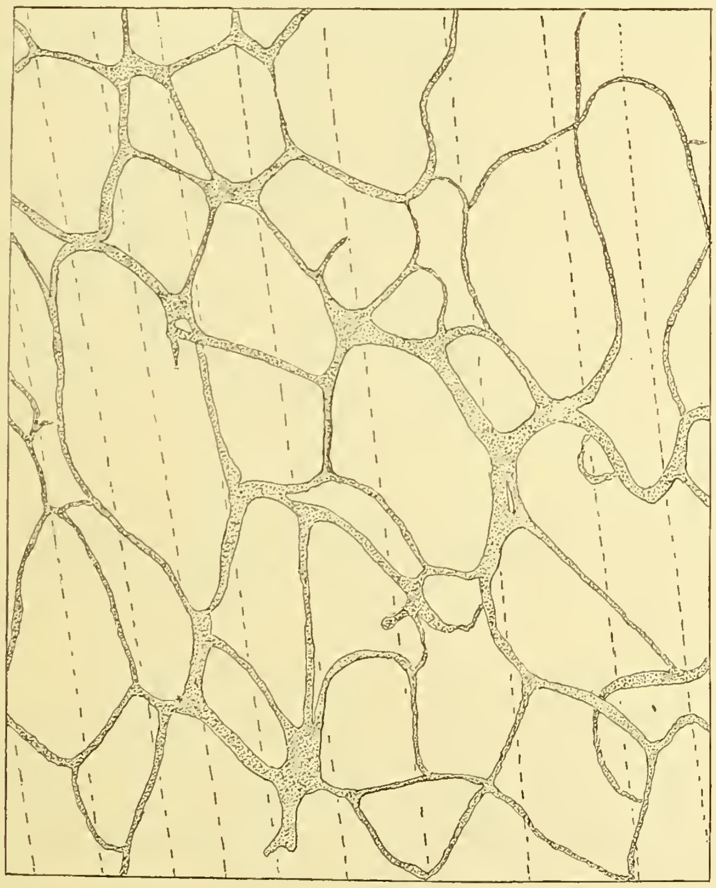
COLOUR in formalin.—Black grey, in the lower part paler; boundary tract of the mesenteries greenish or greenish gray.

SIZE of the polyps in contracted state.—Breadth 0·3–0·4 cm., height 0·3–0·5 cm.

OCCURRENCE.—Three Isles, 6.v.29, St. 46; some colonies on pieces of limestone.

I have sectioned four specimens showing good agreement in their organization. The pigmented cells of the mesogloea are often more numerous than those figured in Text-figs. 12 and 13. On surface preparations, after scraping off the ecto- and endoderm, one can see that the pigmented cells are rather regularly arranged. Sometimes they are situated a little deeper down in the mesogloea. The canals of the mesogloea show in cross-sections an appearance of a ring-sinus (Text-fig. 13), and are mostly situated in the middle of the mesogloea. In preparations made from the surface of the scapus, however, the canal system forms an irregular net of wider and narrower meshes representing finer and larger canals, often strongly swollen in the knots of the meshes (Text-fig. 14). Occasionally the canals are connected with the ectoderm. The ectoderm of the tentacles was thicker on the outside than on the inside. The mesenteries were 46, 48, 50 and 54

TEXT-FIG. 13.—*Zoanthus anneae* n. sp. Transverse section of the scapus. The ectoderm is here not figured.



TEXT-FIG. 14.—*Zoanthus anneae* n. sp. Canal system in the mesogloea of the scapus below the actinopharynx. The discontinuous lines mark the insertions of the mesenteries. Text-figs. 14, 15, 17, 18 are figured at the same magnification and are similarly orientated.

in number. I have not observed any nematocysts of the type *b* (Text-fig. 11) in the ectoderm of the tentacles and filaments, unless opaque or almost opaque cnidae, in the former 9–14 × 2·5μ long, in the latter 10–12 × 2·5–3μ, were of this type.

The species is named after a member of the expedition, Mrs. Anne Stephenson.

The species is characterized, among other things, by the presence of the superficially situated, pigmented cells in the mesogloea of the column, by very numerous spirocnidae and very numerous holotrichs in the ectoderm of the tentacles, and by the structure of the canal system in the mesogloea.

Zoanthus fraseri n. sp.

Diagnosis.—Polyps of the colonies not closely packed, rising from a flat coenenchyme or connected with each other by broad stolons. Ectoderm of the scapus discontinuous, with a rather thick cuticle, without zooxanthellae, but with numerous holotrichs. Mesogloea of the scapus rather thick, with scattered cells, sparse lacunae, almost without pigmented cells, its canal system well developed, forming an irregular network of wider and narrower meshes of broad canals. Upper sphincter weak in comparison with the strong, elongated, lower sphincter, which, however, occupies only about the half of the thickness of the mesogloea. Ectoderm of the tentacles with rather few spirocysts in their apex; on the sides the spirocysts are almost absent. No zooxanthellae, but numerous holotrichous cnidae on the outside of the tentacles. Actinopharynx narrow, its ectoderm smooth or a little longitudinally folded, with yellowish gland-cells distally and pigmented cells proximally. Siphonoglyph only a little differentiated. Mesenteries 54–58, thin. Ciliated tracts of the filaments well developed, as also the boundary tract. Holotrichs of the column 14–17 × 5–6·5μ long; those of the tentacles 13–17 (19) × 5–6μ; those of the actinopharynx 13–17 (19) × 5–6μ; those of the filaments and mesenterial canals 12–17 (19) × 4·5–6·5μ, few; microbasic mastigophors of the actinopharynx 14–19 × 2·5–3μ, common; nematocysts (type *a*) of the actinopharynx about 22 × 4·5μ, few; those of the filaments 22–26 × 3·5–5μ.

Colour in formalin.—Colourless, boundary tract of the macromesenteries dark green grey to almost black.

Size of the polyps in strongly expanded state about 1·8 × 0·25 cm., in a state with the tentacles and the oral disc expanded up to 0·8 cm. broad, in strongly contracted state 0·45 cm. broad.

Occurrence.—General Survey, Low Isles, Section 3a, 10.iii.29; several colonies on piece of limestone.

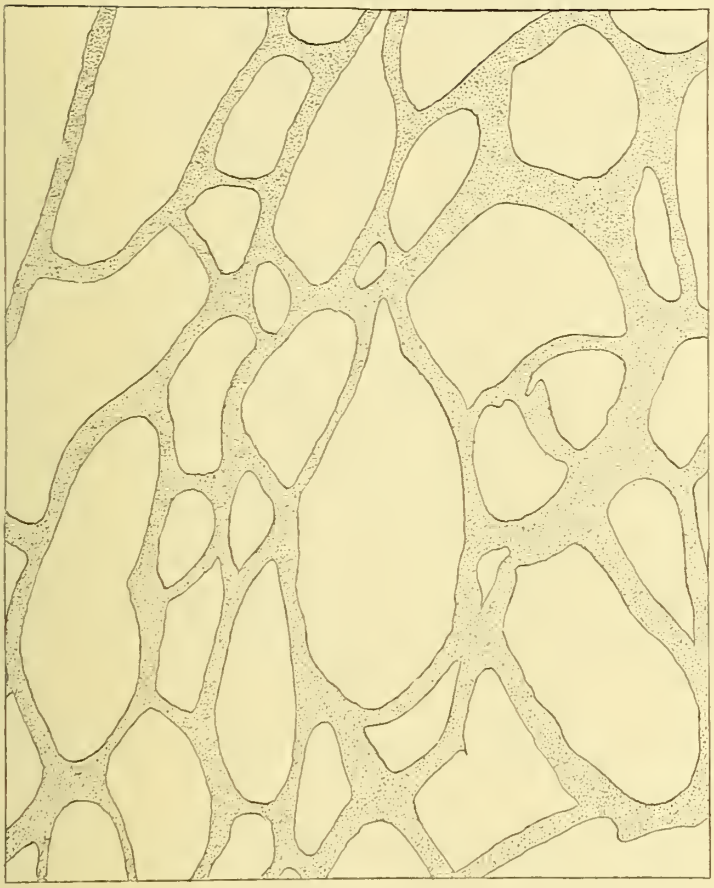
The spirocysts of the tentacles were very reduced in number. Beside holotrichs there were in the tentacles few opaque cnidae 13–14 × 2·5–3μ long. Zooxanthellae were present in the endoderm, especially numerous in the tentacles. Two sectioned specimens show good agreement in their organization. The mesenteries were 54 (28 + 26) and 58 in number. I have figured the canal system in the mesogloea of the column (Text-fig. 15) and of a mesentery with the strong boundary tract (Text-fig. 16).

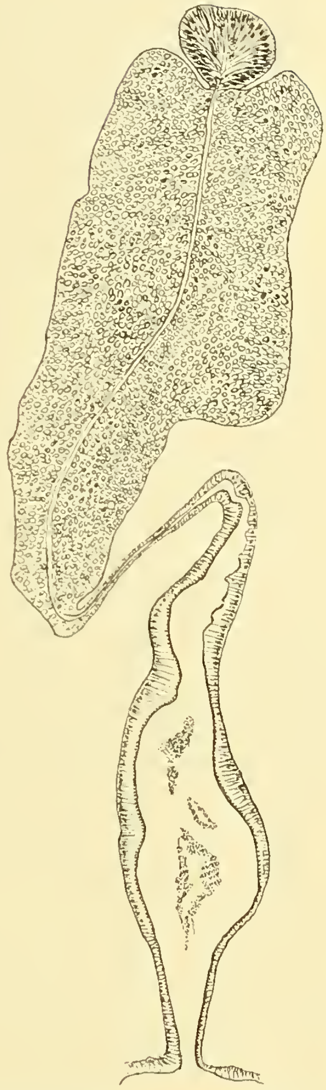
Remarks.—The species is easily distinguished from *Z. anneae* by the almost complete lack of the pigmented cells in the mesogloea and by the reduced number of spirocysts in the tentacles.

I have named the species after Miss E. A. Fraser, D.Sc., a member of the expedition.

TEXT-FIG. 16.

TEXT-FIG. 15.





TEXT-FIG. 15.—*Zoanthus fraseri* n. sp. Canal system in the mesogloea of the scapus below the actinopharynx. Compare Text-fig. 14.

TEXT-FIG. 16.—*Zoanthus fraseri* n. sp. Transverse section of a macromesentery.

Zoanthus mantoni n. sp. (Plate I, fig. 3.)

DIAGNOSIS.—Polyps connected with each other by rather thick stolons or a flat coenenchyme. Ectoderm of the scapus thin, discontinuous. Pigmented cells present, situated mostly more or less deeply in the thick mesogloea of the column. Its canals fine or rather fine, forming mostly larger meshes. Upper sphincter rather weak, lower sphincter very long, diminishing downwards, forming large meshes in its distal part. Actinopharynx smooth or a little folded; siphonoglyph rather distinct, its mesogloea, however, not thickened; hyposulcus distinct. Mesenteries 44–50, micromesenteries well developed. Holotrichs in the ectoderm of the column 12–17 × 4·5–6·5μ, very numerous; those of the tentacles 14–17 × 4–5·5μ, mostly on their outside; those of

the actinopharynx 12–17 × 5–6μ, rather common; those of the filaments 13–18 × 5–6μ; microbasic mastigophors of the actinopharynx 12–18 × 2·5–3μ; nematocysts of the type *a* in the actinopharynx 19–25 × 3–5μ; in the filaments (14) 19–23 × 3–4 (4·5)μ. Spirocysts few in the apex of the tentacles, very rare in other parts, not present in the oral disc. Zooxanthellae absent in the ectoderm, numerous in the endoderm.

Colour in formalin. Yellowish.

Size in contracted state. Height up to about 0·7 cm., breadth 0·2–0·3 cm.

Occurrence.—General Survey, Low Isles. One colony labelled "M_8 28.iii.29"; two colonies—large piece labelled "M_2", small piece; "M_3 22.iii.29".

The polyps were cylindrical, in contracted state the upper part was thicker than the lower. The polyps were connected with each other either by a rather thick and broad coenenchyme or by rather thick stolons—differences due to attachment to a mussel-shell, coarse sand or calcareous algae. The ectoderm of the scapus was certainly discontinuous in the colonies M_2 and M_3, probably also in M_8, the ectoderm of which, however, was badly preserved and mostly lost from the cuticle, to which diatoms and algae adhered. In the mesogloea of the column pigmented cells were present—now more numerous, now more sparse. Mostly they were not situated close to the ectoderm, but more or less deeply in the mesogloea. The canals of the mesogloea were mostly thin, the muscle meshes large (Text-fig. 17), sometimes smaller and the canals partly broader (Text-fig. 18). The distal sphincter was short and consisted of only a few meshes; the proximal sphincter 4–5 times longer than the distal. I have examined the cnidae and the mesenteries in specimens from all colonies. In M_8 the mesenteries were 44 (22 + 22), 46 (22 + 24), 48, 50 and 50 (26 + 24); in M_2 44, 49 (23 + 26) and 50; in M_3 46 (22 + 24) and 48 (24 + 24).

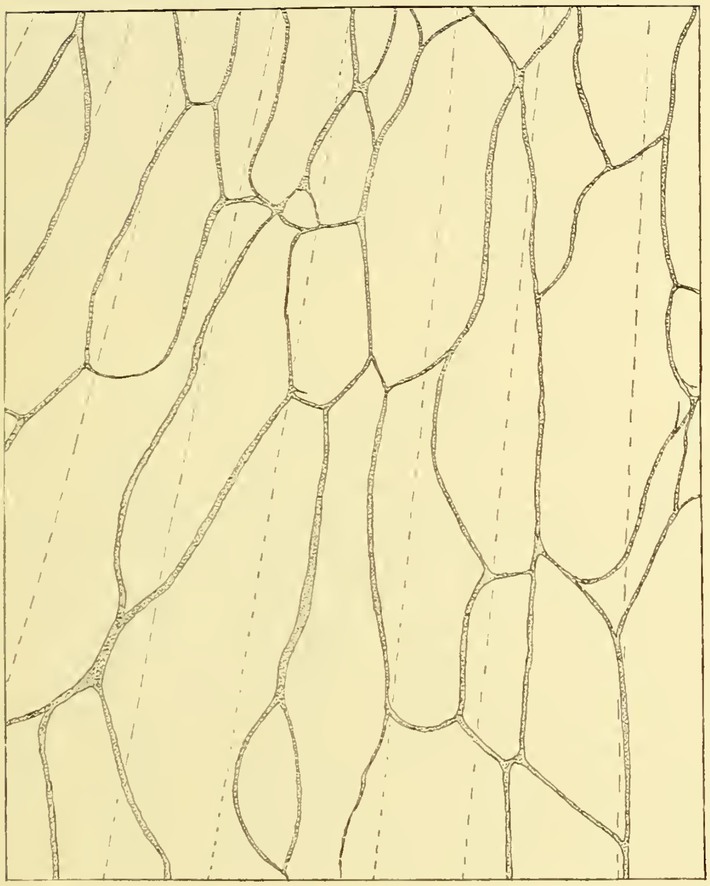
I associate this species with the name of Miss S. M. Manton, Ph.D., a member of the Expedition.

The three species of *Zoanthus* described here are easily distinguished from each other. *Z. anneae* has numerous spirocysts in the ectoderm of tentacles and oral disc. In two, *fraseri* and *mantoni*, the spirocysts in the tentacles are rare, and in the main present only in their apex and in the oral disc lacking (or if present extraordinarily rare ?). *Z. fraseri* has no or very rare pigmented cells in the mesogloea of the column, while in *Z. anneae* and *mantoni* they are numerous; in the former they are arranged close to the ectoderm, in the latter mostly deeper in the mesogloea.

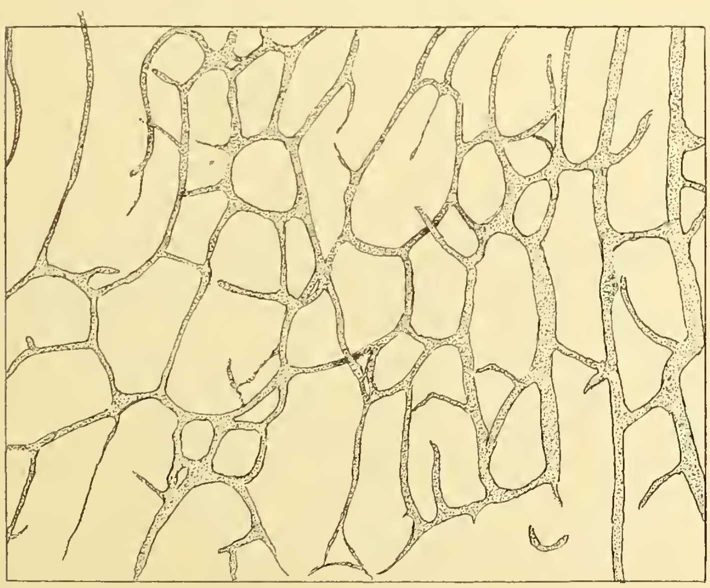
Genus *Palythoa* Lamx.

As to the distribution of the nematocysts in the genus *Palythoa,* Seifert (1928, p. 464) distinguished three types. The first type includes species having macrocnidae (holotrichs) in the ectoderm of the tentacles; to the second type belong all species lacking macrocnidae in the tentacles but having them in the ectoderm of the actinopharynx; the third type lacks macrocnidae in both these organs. In the ectoderm of the column only macrocnidae are present in all types. Among the present species none belongs to the first type. *P. stephensoni* and *kochii* should be referred to the second type, all the others to type 3. Seifert described no craspedocnidae (microbasic mastigophors) from the ectoderm of the tentacles and column, but from the actinopharynx (compare his figs. 4–6). As to the tentacles, there were always craspedocnidae in the present species. I think, therefore,

TEXT-FIG. 17.



TEXT-FIG. 18.



TEXT-FIGS. 17, 18.—*Zoanthus fraseri* n. sp. Canal system of the mesogloea of the scapus below the actinopharynx. Fig. 17 from a polyp of the colony labelled M_6; fig. 18 from M_3.

that Siefert has overlooked them. More seldom they seem to occur also in the ectoderm of the column and coenenchyme, as in *P. howesii, projecta, kochii* and *shackletoni.* In the two latter, however, they are very sparse, while they are very numerous in the first species ; the macrocnidae, on the other hand, are few. Thus I think that if we examine several types, we may take into consideration also the distribution of the craspedocnidae.

Of the *Palythoa* species described by Haddon and Shackleton from Torres Strait I have had for examination pieces of *kochii, caesia, howesii* and *mutuki* (*Gemmaria mutuki*). Only one, *howesii*, have I found in the present collection. Unfortunately Haddon's and Shackleton's species were mostly not well preserved. As to the filaments and mesenteries, I make, however, some comments upon the cnidae of these species.

Palythoa kochii Hadd. & Shackl.

The holotrichs of the coenenchyme and those of the basal part of the polyps were 58–62 × 24–26μ ; those of the actinopharynx 58–65 × 24–26μ, rare ; those of the filaments 60–67 × 24–26μ ; those of the mesenterial canals 55–65 (?) × 24–26μ, few ; the microbasic mastigophors of the column and coenenchyme 24–26 (38) μ 4·5–5μ (very few found) ; those of the tentacles 22–26 × 3·5–5μ ; those of the actinopharynx 26–34 × 4·5–5μ ; those of the filaments 43–53 × about 5μ, rather common ; cnidae of the type *a* (Text-fig. 11) in the filaments 24–31 × 5–6μ, numerous ; spirocysts of the tentacles about 14–24 × 3μ. Moreover, there were, in the filaments, small nematocysts 12 × a good 2·5μ. I have not found any holotrichs in the tentacles. I have examined the filaments of this and the other species from Torres Strait only in maceration preparations and, as it is not easy to isolate them from the other parts of the mesenteries, there is a possibility that some of the holotrichs do not belong to the filaments. In the present collection of *Palythoa* I have examined the filaments also on slides, and in all species holotrichs were present in the filaments. Zooxanthellae occur in the ectoderm of the coenenchyme. One specimen had 42 mesenteries.

Palythoa caesia (?) Dana.

The holotrichs of the coenenchyme and those of the basal part of the polyps were 38–50 × 18–22μ, very numerous ; those of the filaments (compare above) 65–67 × 22–26, few ; those of the mesenterial canals 62–72 × 22–26μ ; the microbasic mastigophors of the tentacles 29–31 × (4) 4·5μ, not rare ; those of the actinopharynx 29–34 × 4·5–5μ, numerous ; those of the filaments 50–55 × 5–6μ, rather common ; nematocysts of the type *a* (Text-fig. 11) 24–26 × about 5μ. Also small nematocysts 12–14 × 2·5–3μ occur in the filaments. The spirocysts of the tentacles were 14 × almost 2–26 × about 3μ. There were no holotrichs in the ectoderm of the tentacles and actinopharynx, and no holotrichs in the ectoderm of the coenenchyme and polyps. I have examined the mesenterial canals in the lower part of the mesenteries. The principal canal is here broad and sends out lobes on both sides, mostly to the inside. It contains numerous holotrichs.

As Haddon and Shackleton have pointed out, it is dubious if the species is Dana's *caesia.* I think not.

Palythoa (Gemmaria) mutuki (Hadd. & Shackl.).

Holotrichs in the ectoderm of the scapus 36–48 × 17–20μ, rather common ; those of the filaments 43–50 × 20–22μ ; those of the mesenterial canals 46–50 × about 19μ, few ; microbasic mastigophors of the actinopharynx 24–28 × 4–4·5 (5) μ ; those of the filaments 22–31 × about 4·5μ ; nematocysts of the type *a* in the ectoderm of the actinopharynx 22 × 5·5μ, very rare, in the filaments 19–31 × 4·5–5μ, common. The mesenterial canals seem to agree rather well with *P. yongei* described below, but they were not well preserved.

Palythoa projecta n. sp. (Plate I, fig. 6.)

Diagnosis.—Polyps large, closely packed, strongly projecting above the surface of the coenenchyme when contracted. The greater part of the polyps, however, connected with each other by coenenchyme. Coenenchyme, column and especially the ridges of the scapules incrusted with calcareous and some sandy particles. Ridges of the scapules 21–22 (24). Tentacles 42–46. Actinopharynx with numerous longitudinal folds formed in the main of the ectoderm ; siphonoglyph well developed, but not broad, its mesogloea distinctly thickened. Mesenteries about 42–46. Mesenterial canals with pigmented cells, below the filaments of rather various appearance, with lobes in the main directed towards the outside of the mesenteries. Ectoderm of the column incrusted with zooxanthellae, which are present also in the ectoderm of the tentacles and oral disc and in the endoderm. Ectoderm of the scapus continuous. Mesogloea of the column incrusted in, at most, its outer half, with numerous cells, in the upper parts of the polyps with few small lacunae, which in the lower part are more numerous and larger. Zooxanthellae in the lacunae. Ectoderm of the tentacles and oral disc, and especially that of the actinopharynx, pigmented. Holotrichs in the ectoderm of the column about 65 × 24μ, rare ; in the tentacles and the actinopharynx absent ; in the filaments sparse, 60–62 × about 24μ ; in the mesenterial canals common, 60–67 × 22–24μ Microbasic mastigophors in the ectoderm of the column rather numerous 30–31 × 3–4μ ; in that of the tentacles 22–24 × 3–3·5μ ; in that of the actinopharynx 25–30 × 3·5–4μ ; in the filaments 43–46 × about 5μ ; nematocysts of the type *a* in the filaments 26–31 × 4·5–5μ ; spirocysts of the tentacles 12–24 × 2–3·5μ.

Colour.—Unknown.

Size.—The colony was about 8 × 7 cm., the breadth of the largest polyps 0·7–0·8 cm., that of the smallest 0·3–0·4 cm. in preserved state.

Occurence.—Locality unknown, probably Low Isles ; one colony.

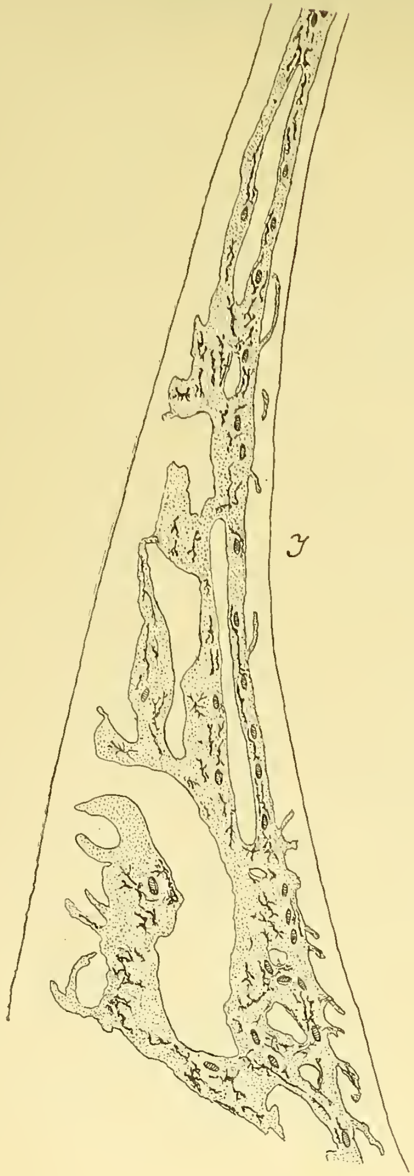
The polyps are very close set, also in their contracted state, their distal part projected considerably, in large polyps 0·7–1 cm. beyond the surface of the coenenchyme, which, however, connected the greatest parts of the polyps with each other. The coenenchyme between the polyps was thin. The free part of the polyps, varying greatly in size, was broader proximally than distally, its upper outline in contracted state of the polyps rounded. The ectoderm of the scapus was continuous, rather thin and provided with a cuticle ; the mesogloea very thick, with numerous small cells and, in the upper part of the polyps, with sparse, rather small lacunae (Text-fig. 19), which, in the lower part, are more numerous. The lacunae of the mesogloea between the polyps are very large ;

exceptionally they can reach a size of 1100 × 200μ, but those measuring about 300 × 200μ were most numerous. They were provided with branched, pigmented cells like those in the mesenterial canals. The holotrichs are few in the lacunae or absent. The incrustation consisting of calcareous particles, some sandy grains and sponge spicules, was not strong, so that the colony felt rather soft; at least the inner half of the mesogloea of the column lacked incrustations, though here and there a particle was situated deeper. The zooxanthellae were numerous in the ectoderm of the coenenchyme and column, as also in the ectoderm of the tentacles and oral disc, but absent in the ectoderm of the actinopharynx. In the endoderm also the zooxanthellae were present. The sphincter was

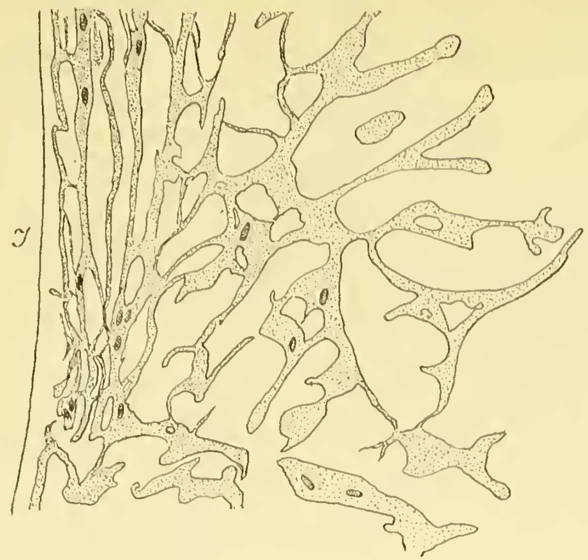
Text-fig. 19.—*Palythoa projecta* n. sp. Transverse section of the scapus. Black circular points, zooxanthellae; black elongated figures, holotrichs. The cavities are remains of the decalcified incrustations. Entoderm not figured.

mesogloeal, forming long rows of meshes, distally somewhat stronger than proximally. The ectoderm of the actinopharynx was high and folded, the folds supported by low triangular projections of the mesogloea. At the base of the ectoderm pigmented gland cells occurred. The siphonoglyph was well developed. The mesenteries were in the two examined specimens 42 and 46 (22 + 24) in number and arranged after the microtype. They were thin, and thickened only in their outer parts and in the region of the boundary tract of the mesenteries. The mesenterial canals below the filaments (Text-figs. 20–22) varied in their appearance. The principal canal passed here on the inner side of the mesenteries, but was mostly longitudinally divided into thinner canals, from which branches ran out towards the outer side. Rarely the branches fused together, so that the canal system had a more compact appearance (Text-fig. 22). Mostly the canals were arranged as Text-figs. 20 and 21 show, the latter in broader, the former in smaller mesenteries. The canal system seems here to vary more than in the other species of *Palythoa* described below. I have examined many mesenteries, but owing to their thinness it was very difficult to get good preparations. The canals were provided with

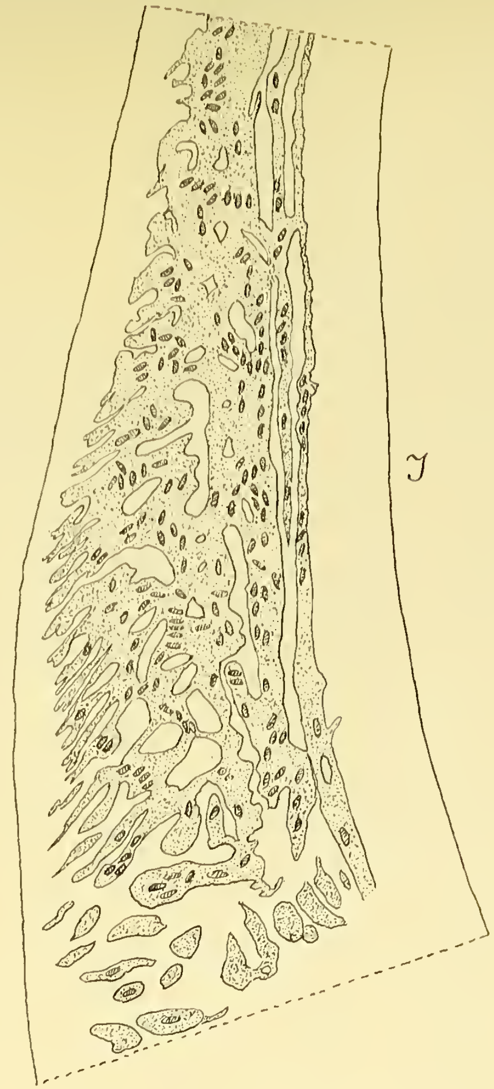
Text-fig. 20.



Text-fig. 21.



Text-fig. 22.



Text-figs. 20–22.—*Palythoa projecta* n. sp. Canal system with holotrichs from the basal parts of three macromesenteries. *I*, inner side of the mesenteries. In fig. 20 the pigmented cells also are figured.

numerous, branched, pigmented cells situated close to the mesogloea (shown only in Text-fig. 20).

Palythoa stephensoni n. sp. (Plate I, fig. 5.)

Diagnosis.—Polyps close standing, not, or only a little, projecting above the surface of the coenenchyme when contracted. Colony flat; ridges of the scapulus distinct, but for the most part invaginated, in number 20–22. Ectoderm of the coenenchyme probably continuous, with a cuticle and with very numerous holotrichs. Mesogloea of the coenenchyme with numerous cells and rather large or smaller lacunae, the largest of the former about 84 × 74μ. Coenenchyme incrusted with calcareous grains and few spicules.

Text-fig. 23.—*Palythoa stephensoni* n. sp. Transverse section of the mesogloea between two polyps. Black circular points, zooxanthellae; black elongated figures, holotrichs. The cavities are remains of the decalcified incrustations.

Zooxanthellae in the ectoderm as well as in the endoderm, especially numerous in the ectoderm of the ridges of the scapulus and in that of the tentacles and oral disc, absent, as it seems, from the ectoderm of the actinopharynx. Siphonoglyph broad, distinct, its mesogloea only a little thickened, with hyposulcus. Mesenteries 40–44. Mesenterial canals very well developed in their lowest parts, lobular on their outer side, more or less branched. Ciliated tracts of the filaments very well developed. Holotrichs in the ectoderm of the coenenchyme very numerous, 41–48 (62) × 17–19μ, from the tentacles absent; those of the actinopharynx 41–53 × 17–19 (22) μ; those of the mesenterial canals 65–73 × 24–25μ; microbasic mastigophors absent from the ectoderm of the coenenchyme; in the ectoderm of the tentacles and actinopharynx varying from 22–25 × about 3μ to 29–43 × 4–5μ; in the filaments 46–58 × 5–5·5μ; cnidae of the type *a* 20–26 × 5μ. Spirocysts of the tentacles about 13–24 × almost 2–3μ.

Size.—Largest colony 4·5 × 4 cm.

Occurrence.—General Survey, Low Isles, 20.v.29; 3 colonies.

Plate I, fig. 5, shows the exterior of a colony, Text-fig. 23 a transverse section of the mesogloea between two polyps. As we see, the lacunae contained holotrichous cnidae and zooxanthellae. The actinopharynx had longitudinal ridges, for the most part formed by the ectoderm, which was pigmented here and there at its base. I have examined the mesenteries in four polyps. They were 40 (20 + 20), 40, 44 and 44 in

TEXT-FIG. 24.—*Palythoa stephensoni* n. sp. Canal system with holotrichs from the basal part of a macromesentery. *I*, inner side of the mesentery.

number. The mesenterial canal was only in its lowest part branched, showing lobular projections towards the outside of the mesenteries (Text-fig. 24). Sometimes there was a more compact canal on the inner side or it was divided into smaller canals ; often it is more branched than Text-fig. 24 shows, but in all examined specimens these lobes were present. The canals contained very few pigmented cells, but the parts close to and inside the filaments, like the filaments themselves, were pigmented. The holotrichous cnidae were very numerous in the principal canal ; commonly few in the lower part of the mesenteries, especially on their outside.

I have named this species in honour of Prof. T. A. Stephenson, the excellent author of the ' British Sea Anemones ' and member of the Expedition.

Palythoa yongei n. sp. (Plate I, fig. 3.)

Diagnosis.—A solitary species, sometimes forming small colonies of few polyps; in the latter case the erect polyps connected by a rather thin coenenchyme at their base. Ectoderm of the scapus with a thin cuticle, probably continuous, with few holotrichous cnidae and very sparse, perhaps no zooxanthellae. Mesogloea of the column comparatively thin, with scattered cells and rather large lacunae, containing sparse holotrichs. Incrustations consisting of calcareous particles, a few grains of sand and some spicules in the ectoderm of the column and in the outer parts of the mesogloea. Sphincter very long, forming a row of muscle meshes. Numerous zooxanthellae in the ectoderm of tentacles and oral disc. Ridges of the scapulus strong, 25–30. Actinopharynx longitudinally furrowed; siphonoglyph broad, its mesogloea strongly thickened; hyposulcus distinct. Mesenteries about 50–60. Mesenterial canals in their lowest part compact towards the outer side, with large lobes and with few holotrichs. Ciliated tracts well developed. Holotrichs of the column 48–58 (60) × 19–22μ; those of the tentacles about 43–47 × 17μ, few; from the actinopharynx absent, those of the mesenterial canals 53–60 × 19μ;

Text-fig. 25.—*Palythoa yongei* n. sp. Transverse section of the scapus. For explanation see Text-fig. 23. Entoderm not figured.

microbasic mastigophors in the ectoderm of the tentacles about 24 × 4–4·5μ, in that of the actinopharynx 26–31 × 4–4·5μ, in the filaments 36–38 × 4–4·5μ; nematocysts of the type *a* in the filaments 29–31 × 4·5–5μ, rather numerous. Spirocysts of the tentacles about 14 × 1·5–24 × 3μ.

Colour in formalin, greyish.

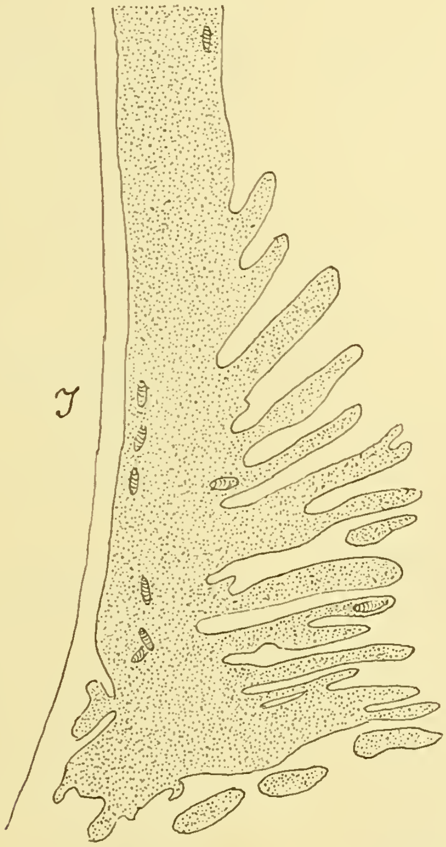
Size of two solitary polyps.—Length 0·8 and 1 cm., breadth 0·4 and 0·6 cm.

Occurrence.—General Survey, Low Isles; 10.iii.29; 1 colony of three polyps. 22.iii.29, 1 polyp. 28.iii.29, 1 polyp (Plate I, fig. 3).

The three cylindrical polyps in the colony were connected with a rather thin coenenchyme at their base; the two solitary polyps had a broad base. The column of the smaller polyps was thin, in the larger polyps thicker. All polyps were contracted, the tentacles not visible, the ridges of the scapulus sometimes as in the figured specimen provided with irregular protuberances. The three largest polyps were in their middle part transversely furrowed. The ridges of the scapulus were in 4 polyps 25, 27, 27 and 30 in number.

The ectoderm of the column was not well preserved and I am not sure that it is continuous, as I have sometimes seen thin strings of mesogloea running out in the ectoderm, but whether these strings are really connected with the thin cuticle is dubious. I have found a few zooxanthellae in the ectoderm of the column, but possibly they do not belong

to the ectoderm. In any case, if present, they are very sparse here. The rather large lacunae in the mesogloea (Text-fig. 25) were often pigmented. The zooxanthellae were common in the ectoderm of the tentacles, more sparse in their endoderm. The ectoderm of the oral disc contained also numerous zooxanthellae ; at its base large gland-cells were present. The ectoderm of the actinopharynx was longitudinally sulcated, that of the broad siphonoglyph unfolded. At the base of the ectoderm of the actinopharynx, as well as in the cnidoglandular and intermediate tracts, pigmented cells were situated.



TEXT-FIG. 26.—*Palythoa yongei* n. sp. Canal system with holotrichs from the basal part of a macromesentery. *I*, inner side of the mesentery.

Two examined polyps had 50 and 50 (24 + 26) mesenteries. Owing to the number of ridges in the scapulus the largest polyp may have had 60 mesenteries. The muscles of the mesenteries were weak. In each mesentery a broad canal containing only a few holotrichs was present. In the basal part of the macromesenteries it ran near the inner side of the mesenteries and sent several lobes towards the outside (based on 4 mesenteries) (Text-fig. 26).

I have named this species after Dr. C. M. Yonge, the leader of the Expedition.

REMARKS.—The species reminds one of *Palythoa* (*Gemmaria*) *mutuki*, but seems to be different from this species. The cnidae of *mutuki* were considerably smaller (compare p. 193) than those of *yongei*, and the incrustations and the lacunae of the mesogloea are not as numerous in the present species as in *yongei*.

Palythoa haddoni n. sp. (Plate I, fig. 7.)

Diagnosis.—Polyps of various sizes, the largest about 1 cm. broad ; close-packed, scarcely or somewhat projecting above the surface of the coenenchyme when contracted. Ectoderm and mesogloea of the coenenchyme and column incrusted with calcareous and sandy particles ; spicules and curious, elongated irregular bodies now in great number, now few and scattered. Ectoderm of the coenenchyme and scapus continuous, with zooxanthellae, which are present also in the ectoderm of the tentacles. Mesogloea of the coenenchyme with numerous very small cells and with lacunae of various sizes, but commonly large (the largest examined was 270 × 230μ). Ridges of the scapulus rather distinct. Actinopharynx longitudinally furrowed ; siphonoglyph distinct, with long cilia ; but its mesogloea not thickened. Mesenteries 36–48. Mesenterial canal below the filaments mostly richly branched between a stronger inner and a weaker outer canal. Holotrichs of the ectoderm of the coenenchyme 50–61 (70) × 23–25μ, absent in the ectoderm of tentacles and actinopharynx ; those of the filaments 46–50 × 22–24μ ; those of the mesenterial canals 70–79 × 24–26μ ; microbasic mastigophors absent in the coenenchyme ; those of the tentacles 21–24 × 2·5–3·5μ ; those of the actinopharynx (34) 36–48 × 4·5–5μ ; those of the filaments 48–53 × 5–5·5μ ; nematocysts of the type *a* in the filaments 22–26 × 4·5–5μ. Spirocysts of the tentacles 12–27 × 1·5–3μ.

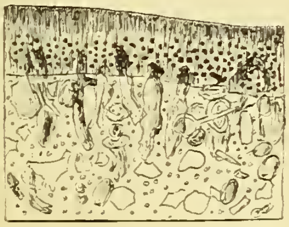
Size.—The figured colony was 5 cm. high and 5·5 × 4 cm. broad, the largest polyp about 1 cm. broad, the smallest 0·2 cm.

Occurrence.—General Survey, Low Isles, Diving Station No. 1, 19.v.29 ; 3 pieces probably belonging to a single colony.

The figured colony (Plate I, fig. 7) has grown over a sponge and so has a cap-like facies ; the other pieces were flattened. In a contracted state the polyps, being of very different sizes, projected not at all or only a little above the surface of the coenenchyme, The best extended polyp reached about 0·5 cm. above the surface. The ridges of the scapulus were partly visible in the less contracted polyps, and the distal outline of the polyps was rounded. The incrustation seems to be stronger in the coenenchyme and in the lower part of the polyps than in the upper region, but it is very unevenly distributed, now very strong, now inconsiderable and only between the polyps. Besides calcareous and sandy particles and a few spicules there are often numerous, curious, long, irregular, closely-set bodies (Text-fig. 27). I have not been able to determine their nature. The mesogloea of the coenenchyme contained numerous small cells and numerous lacunae of various size, the largest I have examined being 270 × 230μ. In these lacunæ zooxanthellae and sometimes also holotrichous cnidae were present. Sometimes numerous cells forming more or less distinct cell-islets were accumulated as an annulus in the vicinity of the polyps (Text-fig. 28). Five examined polyps had 36, 36, 42, 44 and 48 mesenteries. As to the mesenterial canals the distally undivided canal has, in the lower part of the mesenteries, split into two more or less distinct canals, one stronger on the inner side of the mesenteries, and one weaker and not so strongly marked on the outer side ; between them there is a net of branches. Sometimes the canals are not so much divided as Text-fig. 29 shows. I never found such a lobulation of the principal canals as in *Z. yongei* in the many macromesenteries I have examined, all of which showed good agreement in the arrangement of their canals. The mesenterial canals contained very numerous holotrichs, but few pigmented cells.

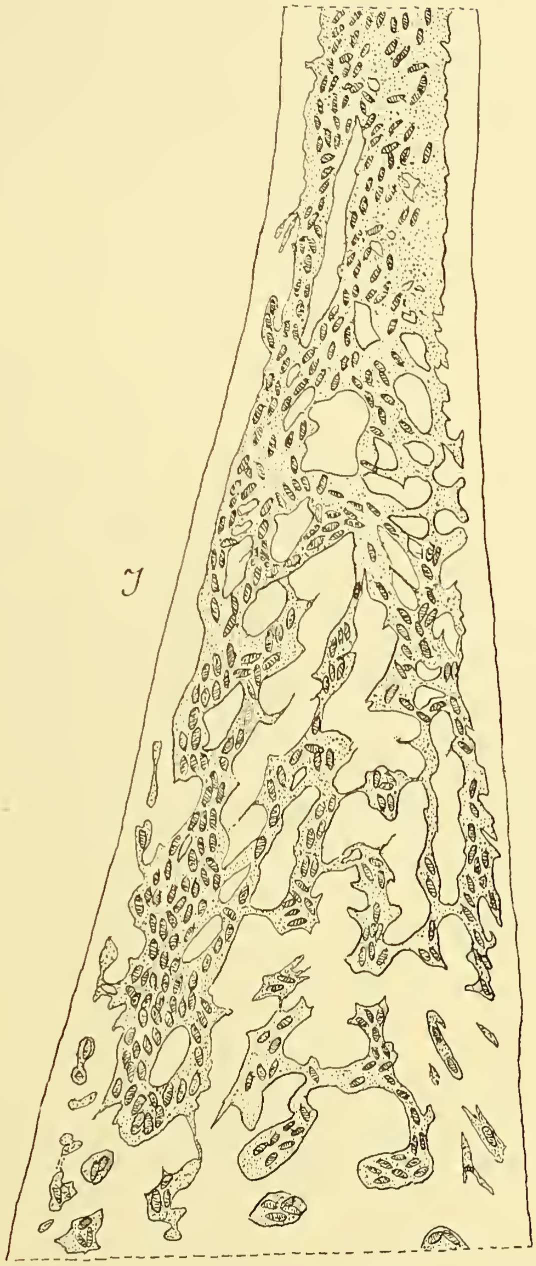
The species is named after Prof. A. C. Haddon, who was the first to use the anatomy of zoantharia for more extensive systematic purposes.

Text-fig. 27.



Text-fig. 28.

Text fig. 29.



Text-fig. 27.—*Palythoa haddoni* n. sp. Transverse section of the ectoderm and a part of the mesogloea of the scapus. In the mesogloea and ectoderm are curious incrustations. Black circular points, zooxanthellae. The cavities are remains of decalcified incrustations.

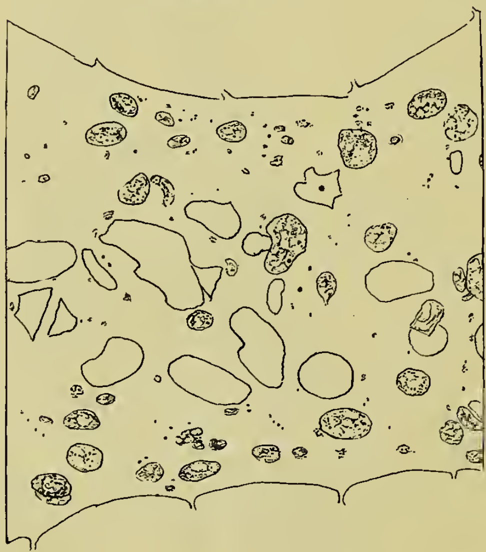
Text-fig. 28.—*Palythoa haddoni* n. sp. Transverse section of the mesogloea between two polyps. At the border of the polyps cell-islets ; in the interior cells, lacunae with zooxanthellae (black points) and cavities (remains of decalcified incrustations).

Text-fig. 29.—*Palythoa haddoni* n. sp. Canal system with holotrichs from the basal part of a macromesentery. *I*, inner side of the mesentery.

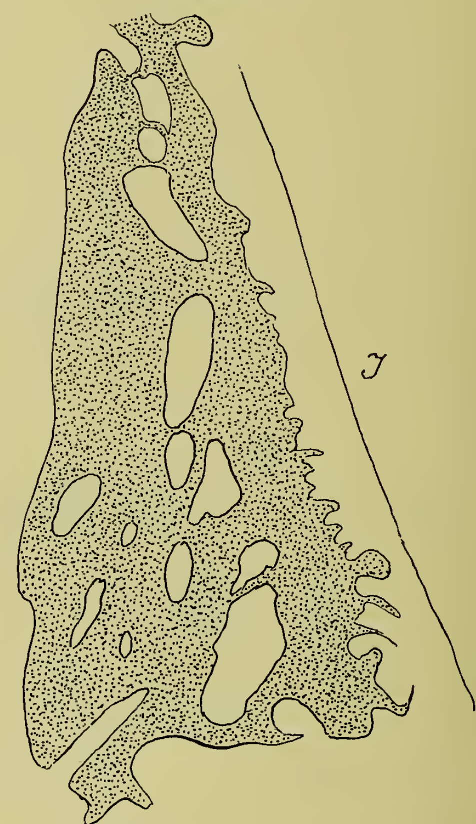
Palythoa australiae n. sp. (Plate I, fig. 1.)

Diagnosis.—Polyps of ordinary size, close packed, projecting little above the surface of the coenenchyme when contracted. Colony rather low. Ectoderm of the coenenchyme continuous with zooxanthellae; numerous holotrichs but no microbasic mastigophors. Mesogloea with rather numerous cells and pigmented lacunae (the largest examined 168 × 144μ), containing few zooxanthellae and holotrichs. Incrustation of the mesogloea strong, consisting of calcareous and sandy grains and few spicules, the ridges of the scapulus especially strongly incrusted. Ridges of the scapulus hardly visible in contracted

Text-fig. 30.



Text-fig. 31.



Text-fig. 30.—*Palythoa australiae* n. sp. Transverse section of the mesogloea between two polyps. Cells, lacunae and cavities of decalcified incrustations.

Text-fig. 31.—*Palythoa australiae* n. sp. Canal system from the basal part of a macromesentery. *I*, inner side of the mesentery. The numerous holotrichs not figured.

state of polyps, in number about 20. Ectoderm of the tentacles with rather sparse zooxanthellae. Actinopharynx longitudinally furrowed, siphonoglyph distinct, its mesogloea strongly thickened; hyposulcus present. Mesenteries about 40. Mesenterial canal in the lowermost part of the mesenteries broad, almost unbranched or a little branched. Ciliated tracts of the filaments well developed. Holotrichs of the coenenchyme 46–50 (55) × 21–24μ; those of the filaments 63–72 × 24–26μ; those of the mesenterial canals 62–72 × 22–26μ, very numerous. Microbasic mastigophors of the tentacles 24–26 × 2·5–3μ; those of the actinopharynx 24–29 × about 3·5 (4) μ; those

of the filaments 46–55 × 5μ ; nematocysts of the type *a* in the filaments about 22 × 4μ. Spirocysts of the tentacles 12 × 2–24 × 4μ. There were no holotrichs in the ectoderm of the tentacles and actinopharynx.

Colour.—Unknown.

Size of the colony, 3·5 × 2·5 cm., breadth of the largest polyps 0·6 cm.

Occurrence.—Detailed Survey, 6.v.29 ; 1 small colony.

The mesenteries numbered 40 in the two examined large polyps. I have, in Text-fig. 30, given a reproduction of a section of the mesogloea between two polyps. The mesenterial canal (Text-fig. 31) seems, in its lower part, to be almost unbranched. It was, however, difficult to get good preparations of the canal system, as the macro-mesenteries were narrow in their proximal part. The mesenterial canals contained numerous holotrichs, as also pigmented cells ; the latter were common also in the filaments and outside them.

Palythoa howesii Hadd. & Shackl. (Plate I, fig. 2.)

Palythoa howesii Haddon & Shackleton, 1891, pl. lxi, fig. 13 ; pl. lxiii, fig. 8.

Diagnosis.—Polyps scarcely or slightly projecting above the surface of the coenenchyme when wholly contracted. Ridges of the scapulus distinct, broad, but in the contracted state of the polyps mostly not visible from the surface of the colony. Colony rather high. Coenenchyme, column and especially the ridges of the scapulus strongly incrusted with calcareous grains occupying the whole mesogloea and with some sandy particles. Ectoderm of the coenenchyme apparently continuous with zooxanthellae ; mesogloea thick, with numerous cells and many, but not large, lacunae, the latter often with zooxanthellae and holotrichs. Ectoderm of the tentacles with zooxanthellae. Siphonoglyph well developed, its mesogloea thickened ; hyposulcus distinct. Other parts of the actinopharynx longitudinally furrowed. Mesenteries 40–46. Mesenterial canals in their lowest part broad and only a little branched, without lobes on the inner or outer side. Ciliated tracts well developed, long. Ectoderm of the coenenchyme and column with holotrichs 53–60 (67) × about 26μ—in the former few, in the latter somewhat more numerous. On the other hand, the microbasic mastigophors are extraordinarily numerous in the ectoderm of the coenenchyme, and present also in that of the column, but not in such numbers and measuring 29–41 × 5·5 (6)μ. Holotrichs in the ectoderm of tentacles and actinopharynx absent ; in the filaments 60–73 × 24–29μ ; in the mesenterial canals 60–70 × 22–26μ, very numerous ; microbasic mastigophors in the ectoderm of the tentacles 22–26 × 3–3·5μ ; in that of the actinopharynx 31–36 × 4–4·5μ ; in the filaments 46–48 × 5–5·5μ. Nematocysts of the type *a* in the filaments 29–36 (41) × 5–5·5 (6) μ, common ; spirocysts of the tentacles about 14 × 2–26 × 3·5μ at least.

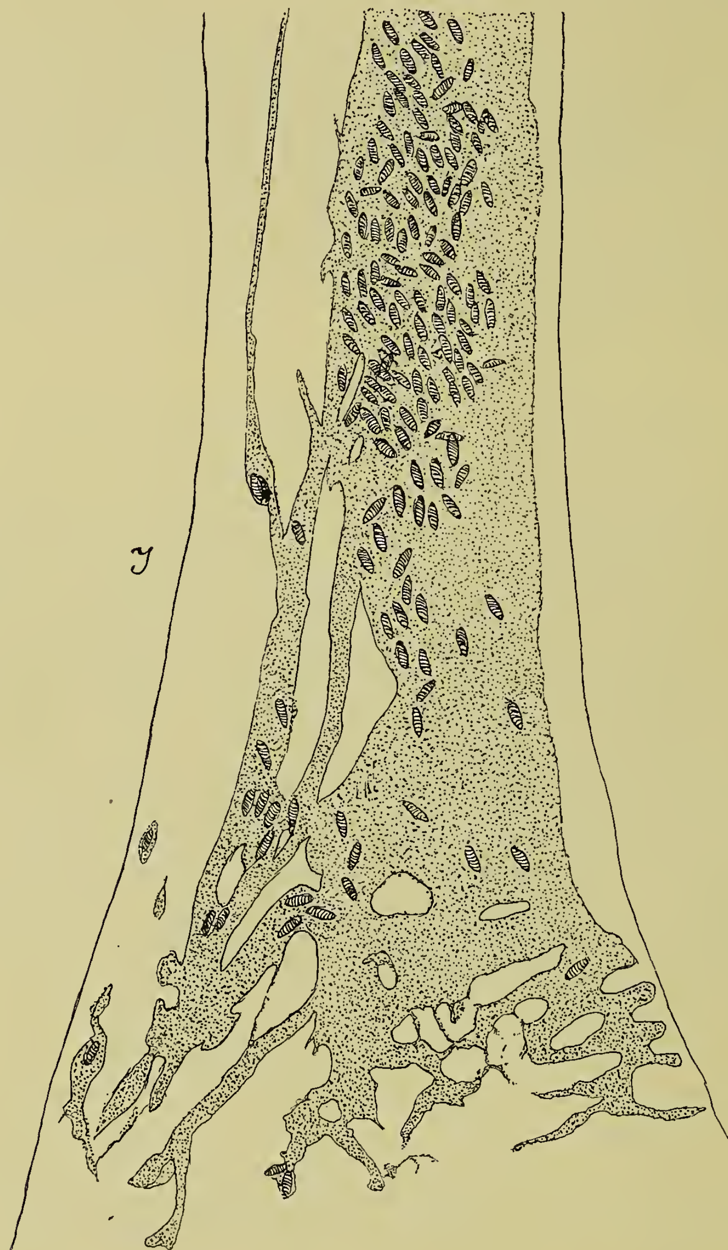
Size.—Breadth of the colony about 6 × 6·5 cm. ; breadth of the largest polyps 0·7 cm. ; of the smallest 0·3 cm.

Occurrence.—General Survey, Low Isles ; the common *Palythoa* 20.v.29 ; 1 colony divided into two parts, the one smaller than the other and only at their bases communicating with each other.

Further Distribution.—Fringing reef, Thursday Island.

I have identified the present species with *P. howesii* Hadd. & Shackl., as the exterior of the colonies as well as the size and distribution of the cnidae among other

things agree rather well. The differences in organization are very small. The zooxanthellae were apparently more numerous in the ectoderm of the column in the present colony than in that described by Haddon and Shackleton. These authors give no information



Text-fig. 32.—*Palythoa howesii* Hadd. & Shackl. Canal system with holotrichs from the basal part of a macromesentery. *I*, inner side of the mesentery.

about the number of the ridges of the scapulus and of the mesenteries. I have examined the mesenteries in five polyps. They were 40, 40, 41, 44 and 46 (24 + 22). A large polyp from the holotype had 44 mesenteries. The ridges of the scapulus may then have numbered 20–23. The mesenterial canal was broad in the undermost part of the mesenteries, and only a little or hardly branched, sometimes divided into two longitudinal canals. There are no such lobes issuing from the canal as in *projecta*. In Text-fig. 32

I have figured the canal of a mesentery in its lowest part. I have found much the same appearance of the canal system in some other mesenteries examined. The mesenterial canals contained numerous holotrichs and pigmented cells; the latter were present also in the filaments and outside them. Unfortunately I have not been able to make an examination of the canal system at the base of the mesenteries of the holotype, because the strongly extended and narrower mesenteries had been cut off in the piece lent to me by the British Museum.

The examination of the cnidae of the holotype showed good agreement with that of our colony. The cnidae of the holotype were as follows: Holotrichs in the ectoderm of the coenenchyme 55–58 × 24–26μ, long, rather common; those of the mesenterial canals 60–67 × 24–26μ, very common; microbasic mastigophors in the ectoderm of the coenenchyme 38–41 × about 5μ, rather common; in the ectoderm of the tentacles and actinopharynx 22–26 × 3·5–4μ and 30–34 × 4·5–5μ respectively, common; those of the filaments 43–50 × about 6μ; nematocysts of the type *a* 29–31 × 5–6μ, very common; spirocysts of the tentacles 14 × 2 to about 25 × 4–4·5μ. In the diagnosis above I have given the size and distribution of the cnidae in the present colony.

Remarks.—In the gastral cavity of two polyps of the holotype there were two specimens of the parasitic genus *Baccalaureus*.* The presence of the parasite was indicated by a porus on the side of the colony.

Palythoa shackletoni n. sp. (Plate I, fig. 4.)

Diagnosis.—Polyps scarcely or slightly projecting above the surface of the coenenchyme when contracted. Ridges of the scapulus cover wholly or partly in contracted polyps. Coenenchyme, polyps and especially the ridges of the scapulus mostly strongly incrusted with calcareous grains, which occupy the whole or almost the whole mesogloea. Ectoderm of the coenenchyme and scapus continuous, with very numerous holotrichous cnidae and numerous zooxanthellae. Mesogloea of the coenenchyme and polyps thick, containing numerous cells and larger or smaller lacunae, especially in its inner part. Holotrichs and zooxanthellae in the larger lacunae. Zooxanthellae numerous in the ectoderm of tentacles and oral disc, and present in all parts of the endoderm. Microbasic mastigophors numerous in the apex of the tentacles. Siphonoglyph distinct, with thickened mesogloea; hyposulcus present. Other parts of the actinopharynx smooth or longitudinally sulcated, with numerous gland-cells at the base of the ectoderm. Mesenteries (40) 42–52. Mesenterial canals in their lowest part much branched, principal canal mostly on the inside of the mesenteries. Holotrichs in the ectoderm of the coenenchyme and polyps 38–50 × 17–22μ; those of the filaments 55–67 × 22–26μ; those of the mesenterial canals 53–62 × 22–24μ, rather numerous. Microbasic mastigophors in the ectoderm of the tentacles and actinopharynx 22–25 × 2·5–3μ and (26) 29–31 × about 4μ respectively, very numerous; those of the filaments 46–53 × about 5μ; nematocysts of the type *a* 19–24 × 5μ in the filaments, sparse; spirocysts of the tentacles about 14–24 × 2–4 (4·5) μ.

Size.—Largest colony 7 × 6 cm.; largest polyps 0·7–0·8 cm. broad; the figured colony (Plate I, fig. 4) was 6·5 × 5·2 cm.

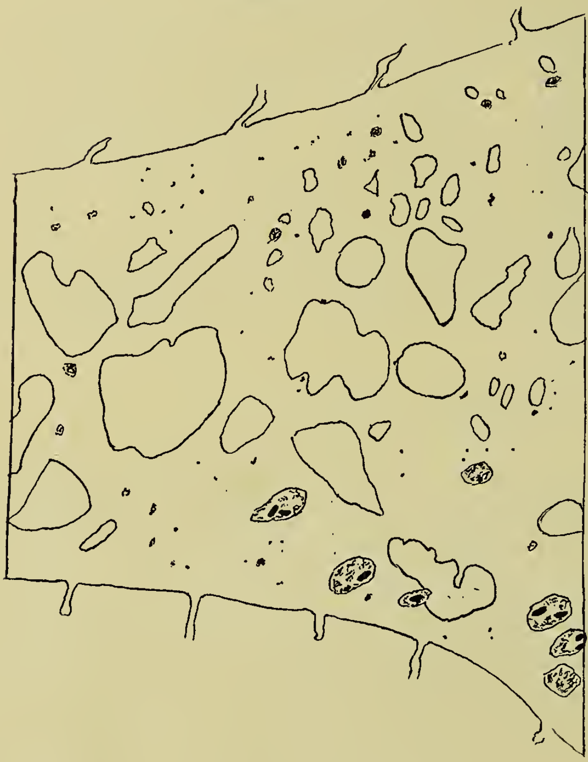
Occurrence.—General Survey, Low Isles, A71, 24.iv.29; 4 colonies.

There were no holotrichs in the ectoderm of the tentacles and actinopharynx.

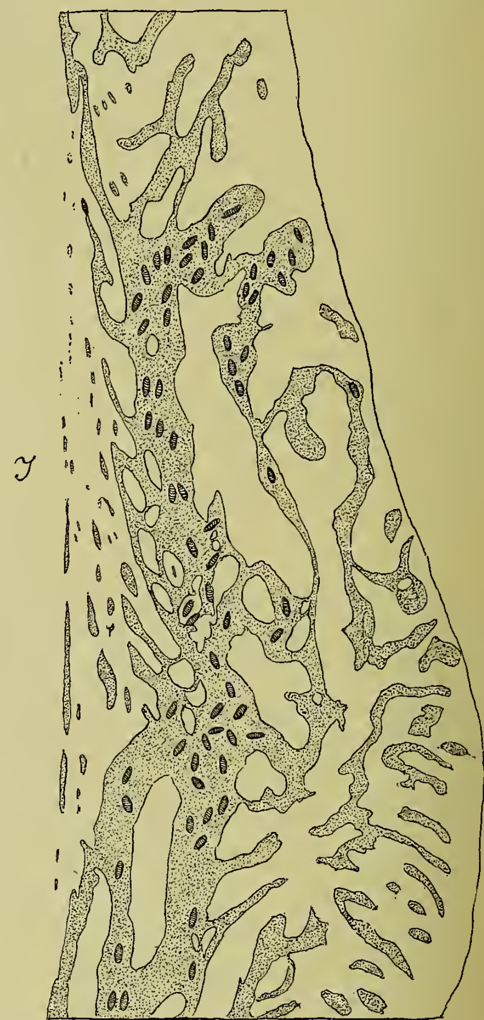
* *Baccalaureus torrensis*, sp.n., Pyefinch, Proc. Linn. Soc., London, 1937, p. 156 [Editor].

and no microbasic mastigophors in the ectoderm of the coenenchyme and column. Text-fig. 33 shows a section of the coenenchyme between two polyps. The number of mesenteries varies. A small polyp had 40. The other examined polyps were provided with 42–52 mesenteries: 42 (20 + 22), 42 (20 + 22), 44, 46, 46, 46, 46, 48, 48, 50, 52.

Text-fig. 33.



Text-fig. 34.



Text-fig. 33.—*Palythoa shackletoni* n. sp. Transverse section of the mesogloea between two polyps. Black elongated figures in the lacunae, holotrichs. Cells and cavities, remains of decalcified incrustations.

Text-fig. 34.—*Palythoa shackletoni* n. sp. Canal system with holotrichs in the lower part of a macromesentery at the end of the cnidoglandular tract.

The mesenterial canals are more branched than in the other species of *Palythoa* described here and are strongly ramified even at the end of the filaments (Text-fig. 34). The reduced principal canal ran on the inner side of the mesenteries in five examined macromesenteries ; in a sixth on the outer side.

The species is named after Miss Alice Shackleton, who, together with Prof. A. C. Haddon, described the zoantharia from Torres Strait.

Comparing the species of *Palythoa* described here, *howesii*, *projecta*, *haddoni* and *yongei* are certainly good species and easily to be distinguished from *P. stephensoni*, *shackletoni* and *australiae*, which are nearly related to each other. But as there seem to be some differences I have set up the latter as separate species. I agree with Haddon and Shackleton (1891*b*, p. 697) when they say: "But we would like to add another warning as to the extreme difficulty in identifying the species of this genus".

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MOLLUSCA

PART I

BY

TOM IREDALE

Conchologist, Australian Museum, Sydney

WITH SEVEN PLATES

(By permission of the Trustees of the Australian Museum)

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MOLLUSCA

PART I

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A FULLY representative series of the Marine Molluscan Fauna of a coral reef cannot be collected in any one season, because the opportunities vary with the seasons. Thus a collection made in winter with low tides will be larger and will show more variety than a collection made on the same reef in summer, with its comparatively unfavourable tides. Of course shore collecting can be supplemented by dredging, but since the great charm of dredging is its unexpectedness, little reliability can be allowed it as a means for obtaining complete collections. Further, shore collecting on every small reef differs, sometimes appreciably, so that results from one small reef cannot be regarded as representative of the reef as a whole. Many collections had been made on the Great Barrier Reef from end to end, but before this Expedition no long sojourn had been made on any reef. The study of the faunula of one reef was not the aim of the Expedition, so that only chance collecting was undertaken. However, I was invited for a month to make an intensive collection of the apparent molluscan fauna for the purposes of generalization. Later I was given another shorter opportunity to compare or contrast another reef. These collections constitute the basis of this report, which, however, has been augmented by a few dredgings made by the members of the Expedition in the waters more or less adjacent to Low Isles. Upon being given the task of reporting upon the Low Isles Mollusca I was asked to deal with the relationships of the forms in view of certain questions. This has entailed a review of the known mollusca of the Great Barrier Reef and the mainland in conjunction with a survey of the whole of the Indo-Pacific area, and thus has taken considerable time. Hitherto it has been quite a common procedure to record a species with a long list of synonymic references, mostly unchecked even in literature and almost certainly not verified by means of specimens, and thus record a wide distribution covering the whole Indo-Pacific area. In this account that method is not followed, but all the Queensland specimens have been compared with material from extralimital sources and then with topotypes, so that accuracy could be to some extent achieved. For the purposes

of ecological study accurate determination of species is a necessity. It will be seen from a study of the following pages how many unexpected problems have appeared through this search for accuracy, and how useless most of the available reports have proved to be. Before entering into details I must place on record the assistance given by the British members of the Expedition; Dr. Yonge, the leader, initiated dredging excursions for the purpose of collecting specimens and helped me in every way; Mr. F. S. Russell with his keen eye detected many novelties; and Mr. G. W. Otter, by his laborious investigation of the animals boring into coral, revealed an unexpectedly rich fauna and inaugurated a new viewpoint in their study.

The matter hereafter will be divided under headings dealing with the location, history, geography of the reef, as without these the systematic account would not be so easily appreciated. There seems to be an idea abroad that Australia is quite sufficient to indicate the origin of a mollusc, but to the local worker " Australia " is so vague that it must be ignored. Four or five distinct faunulas are included in that region, and unless the exact locality is given errors will be continued, and for the past forty years it has been a difficult matter to eliminate the vagueness recorded by early workers.

The excellent plates have been prepared by Miss Joyce K. Allan, of this Museum, and these make identification easy when topotypical specimens are compared, as they have been continually tested since completed. The photographs of Oysters were taken by Mr. G. C. Clutton, of this Museum, and portray this kind of shell better than drawings, and are very good representations of their subjects.

HISTORICAL ACCOUNT.

In order to be able to understand the molluscan fauna of the coral reefs of Queensland it is necessary to know the history of the exploration of the Reef.

Thus we have to go back to the voyage of Captain Cook, whose naturalists were interested in shells, especially Solander, and thus we find in the Portland Catalogue, p. 178, "Lot 3832. A very large and fine specimen of the white variety of Ostrea Malleus, *L.* brought by *Captain Cooke,* from the *Coral Reef,* off *Endeavour River,* on the coast of *New Holland—very rare*". The value attached to this may be gauged by the fact that four guineas was paid for it, while only three pounds five shillings was given for the preceding lot, " An exceeding fine and large Cypraea Aurora *S.* or the Orange Cowry, from the *Friendly Isles,* in the *South-Seas, extremely scarce* ".

The Hammer Oyster passed into the collection of the Prince of Calonne, and we next read of it in the 'Museum Càlonnianum', 1797, p. 44, under the genus *Margaritifera,* as follows :

> " 819. Bipennis—*a.* Long with short arms, New South Wales. This was brought home by Capt. Cook on his first voyage round the world, and was got on the coral reef off Endeavour River. M.P. 3832."

In Captain Cook's 'Journal' [ed. Wharton, 1893, p. 284] we read: "landed upon one [shoal or coral reef] which drys at low Water, where he found very large cockles and a Variety of other Shell fish, a quantity of which he brought away with him." It must be remembered that this collection of shellfish was for the purpose of food, but also that with such a keen naturalist as Solander at hand, novelties would be quickly saved as specimens. In his review of New [South] Wales Cook epitomized: "The Shell fish are Oysters of 3 or

4 sorts, viz., Rock Oysters and Mangrove Oysters, which are small, Pearl Oysters and Mud Oysters; these last are the best and largest I ever saw. Cockles and Clams of several sorts, many of those that are found upon the Reefs are of a prodigious size, Craw fish, Crabs, Muscles, and a variety of other sorts." Here again it was the food value that mostly interested Cook in his account. After Cook came Flinders, and we have no record of his activities in shell collecting save the regrettable note after the wreck on Wreck Reef: "My little collection in mineralogy and conchology was much defaced, and one-half lost".

Thus we arrive at the fact that every shell known from Queensland before 1820 must have been procured by Captain Cook's party, and hence we can get the exact type locality. This is important, as will be seen hereafter, owing to the confusion with the species described by Lamarck. King traversed the East Coast some three times, and although he had on board that excellent naturalist Allan Cunningham, there are no definite novelties known to have been collected on these trips. There is, in the Appendix, an article dealing with shells brought home, but unfortunately in nearly every instance the locality whence they came is not stated. Most of King's work was done on the north-west coast of Australia and the novelties have been commonly assigned to that locality, but under *Cypraea tigris* is written: "The shells of this species that are found on the North-East Coast of Australia are generally of a very pale colour, with only scattered markings." The only note of shell-collecting on the Queensland coast appears to be as follows: "A boat conveyed Mr. Montgomery and Mr. Cunningham to Clack's Island. The reef abounded with shells, of which they brought back a large collection, but not in any great variety; an indifferent *cypraea* was the most common; but there were also some *volutae* and other shells."

Then twenty years later came the first Frenchmen, who, in the Voyage au Pôle Sud, stayed, rather unwillingly, in Torres Straits for nearly a fortnight visiting Darnley Island, Warrior Island and others from 31st May to 12th June, 1840. The results of their shell-collecting were not published, owing to the illness of the naturalist Hombron, until a dozen years later. In the meanwhile there had been two British exploring expeditions along the Queensland coast, and as the places they visited are very important to-day, the routes are here given.

First, there was the visit of the "Fly", commanded by Capt. Blackwood, whose lieutenant, Ince, was interested in natural history and even collected shells. As geologist, J. B. Jukes had been appointed, and as zoologist, J. Macgillivray, employed by the Earl of Derby, was permitted to accompany the expedition. Each was to be given every facility to collect, with the proviso that one perfect specimen of every kind was to be considered public property and to be disposed of as the Admiralty desired. Consequently we read in connection with the description of new species by J. E. Gray, of the British Museum, issued in the Appendix to the 'Narrative of the Voyage', "A considerable number of Shells were collected during the expedition; Mr. Jukes and the Earl of Derby sent many to the British Museum, and the others were sent by Mr. Jukes to Mr. Cuming".

The survey was begun at Sandy Cape, thence through the Bunker and Capricorn Group, touching at Lady Elliott's Island, One Tree Island, Heron Island and Wreck Island: examined the Swain's Reefs, and from there to Port Bowen, where they stayed for a fortnight repairing the ship and surveying the port. From there northward the "Fly" stuck to the mainland. Apparently the ship called in at West Hill, then surveyed

the coast, Cape Hillsborough and Port Molle being names commonly quoted, to Cape Upstart, where six weeks were spent, thence to Rockingham Bay, which was surveyed, and Goold Island visited. From there the " Fly " went direct to Lizard Island, calling in at the Endeavour River for an hour, and surveyed the outer edge of the outer Barrier from Lizard Island to Murray Island. On this section they called in at Cape Melville, Sir Charles Hardy's Isles (where shells were plentiful) and Raine's Island. They visited Evans Bay at Cape York.

A second trip from Sydney to fix a beacon on Raine's Island was undertaken and on the way the ship watered at Cape Upstart, and later at Sir Charles Hardy's Islands. While working at Raine's Island the " Fly " was tendered by the " Bramble ", " Prince George " and the " Midge ", and afterwards the " Bramble " surveyed Endeavour Strait, the " Fly " also assisting in the survey between the Strait and Raine's Island. While more complete surveys were subsequently performed the same ground was covered, but this is not a detail of the surveys, only a collation of the places visited whence shells might have been collected by Jukes and Macgillivray. Port Essington was visited more than once and in literature there are many records of shells from " Northern Australia " collected by Jukes, and it has been a source of great difficulty to determine the approximate locality whence such came. The above review names all the likely places, and from collections made at these places we can fix the type-localities of most of the shells in question.

Almost immediately the " Rattlesnake " was sent out under Capt. Stanley to follow up the " Fly's " results, and J. Macgillivray was appointed as naturalist. Owing to the death of Capt. Stanley an account of the voyage was written by Macgillivray, and zoology is well catered for in that account, especially as Macgillivray was probably the best and most careful collector that ever accompanied an expedition of this kind. Some of his notebooks are still preserved in the British Museum (Natural History), and they are models in their meticulous care for ecological data. As a matter of fact, they provided Prof. Edward Forbes with the opportunity of writing the first ecological essay on the mollusca of East Australia which appeared as an Appendix to Macgillivray's 'Narrative'. While the " Rattlesnake " followed the route of the " Fly ", it varied its course a little, and thus we must record its stopping-places also, especially on account of the vigour of Macgillivray's shell-collecting. A fortnight was spent in Moreton Bay under the lee of Moreton Island, and then three weeks were employed in surveying Port Curtis, Facing Island being visited for collecting purposes. Percy Isles were called at, and then a couple of days at Port Molle found no water and north of Cape Upstart none was found, so the " Rattlesnake " returned to Sydney. On the way back Macgillivray landed on Keppel's Isle and some zoological notes are given, but in this case shells are not mentioned.

A second trip was made as winter approached, and the " Rattlesnake " sailed direct to Cape Upstart. Thence to Rockingham Bay, where Goold Island was visited, and a stay of ten days was made at Dunk Island ; then at the Barnard Isles and the Frankland Islands. In connection with the latter place the enthusiasm instigated by Macgillivray's efforts is seen in the extract, " The reef furnished many radiata and crustacea, and as usual the shell collectors, consisting of about one-half the ship's company, reaped a rich harvest of cowries, cones, and spider shells, amounting to several hundredweight ". Fitzroy Island was the next call, then an unnamed islet in Trinity Bay, obviously Double Isle, and onward to *Low Isles*. Here they remained for four days, and Macgillivray was

apparently very interested, as he wrote a couple of pages indicating the fauna, which is quoted elsewhere. Then Hope Islands, Three Isles, Two Isles were touched at before Lizard Island was reached, where a fortnight was passed. While here Macgillivray crossed to Eagle Island, about which he wrote, " The reef, which is very extensive, did not dry throughout at low water, but some sand banks along its lee margin were exposed, and upon them I found the greatest assemblage of ' pretty ' shells that I have ever met with at one place. What would not many an amateur collector have given to spend an hour here ? There were fine *Terebrae* in abundance, orange-spotted mitres, minutely-dotted cones, red-mouthed *Strombi*, glossy olives, and magnificent *Naticae*, all ploughing up the wet sand in every direction." From Lizard Island to Cape York stops of short duration were made at the Howick Isles, Cape Melville, Pipon Islets, Pelican Island, Claremont Group, Night Island, Sherrard Isles, Isle off Cape Direction, Cape Weymouth, Home's Group, Sunday Island, Bird Isles and Cairncross Island. A fairly long stay was made at Evans Bay, Cape York, and Macgillivray landed on Albany Island several times.

As noted above, Prof. Edward Forbes discussed the mollusca from an ecological viewpoint, and concluded: "During this voyage notes of the habits of considerably more than a thousand species of Mollusca and Echinodermata were carefully registered." In Forbes's essay we note many dredgings about which Macgillivray had not written in his 'Narrative'; thus, " Some seventeen or eighteen localities in this Bathymetrical province (Laminarian region of the European seas) were explored by the dredge, varying in depth from one to seventeen fathoms ". Off Cape York in 3 to 5 fathoms, off Cape Upstart, off Cape Capricorn, off the Percy Isles in 17 fathoms, off the Cumberland Islands in 8 to 11 fathoms and off Cape Capricorn in 15 to 17 fathoms are places and depths specifically mentioned, while a deeper dredging of 27 fathoms off Cumberland Island was very productive, as especially noted.

These expeditions carried back so many shells that innumerable specimens fell into the hands of that indefatigable conchological collector, Hugh Cuming, and were described from that source. The ones deposited in the British Museum were scarcely noticed, and when Reeve named the Australian shells collected by Jukes and Macgillivray many localities were vaguely given, and in order to re-establish the species the preceding data have been collated. In the systematic portion of this Report some of the solutions arrived at through this knowledge will be presented.

A private collector, F. Strange, collected at Moreton Bay prior to 1852, and taking his wares to England sold them to Cuming and entered into contracts to secure more. He was accompanied by a young enthusiast named Spurling, and these were murdered on the Percy Isles while shell-collecting on 15th October, 1854. Many novelties had been previously secured by Strange, and the name is well known in conchological records. A more fortunate student was Samuel Stutchbury, who was the first Government Geologist in Queensland from 1853–1858, but who is much better known from his capture of a living *Trigonia* in Sydney Harbour, which, to his horror, leapt overboard. Systematists remember him more from his introduction to Conchology of the genera *Cleidothaerus* and *Myochama*, both extraordinary bivalves from Sydney Harbour, which, however, occur also in Queensland.

Although only two species were described from dredgings made by Commodore Loring of H.M.S. " Iris " while in Queensland waters from 1856–8, probably other shells

are preserved in the British Museum from that source. The famous Australian conchologist, George French Angas, visited Queensland in 1858, but made no contribution to its conchological history, though he sometimes mentioned the shells he had collected there, which may still be preserved at Newcastle or be in the British Museum. The Godeffroy Company in the 'sixties of the last century had many collectors among the Pacific Islands, and at least two visited Queensland. The enthusiastic lady, Frau Amalie Dietrich, travelled along the coast collecting at various places, and even calling at Holbourne Island. Herr Dämel collected at Cape York, and while most of their molluscan captures were only listed in the little trade catalogues published by the Company, Dunker described one or two novelties.

The Australian Expedition to observe the eclipse of the sun in 1871 was accompanied by that great shell-collector, J. Brazier, who made collections at the stopping-places Percy Isles and Fitzroy Island *en route*, and especially at their rendezvous Claremont Island No. VI, since known as Eclipse Island. Other matters delayed any report, so Brazier published a small note describing eleven new species, mostly from Fitzroy Island. He also issued an account of the mollusca of that isle.

Then came the visit of the famous "Challenger", which had been to Sydney and thence to Fiji, from which it came to Torres Straits, where some ten days were employed in dredging and shore collecting, the first deep-sea haul in Queensland waters being made at this time. It may be noted that Station 188 in the Arafura Sea just falls inside the Queensland boundary, the mollusca from that locality having been omitted by Hedley from his Queensland list. In the magnificent publication, which did not appear until over ten years later, the Queensland species were recorded up to the number of two hundred and twenty-three (223). Some of the very deep-sea novelties have not been seen since. The "Challenger" was in Torres Straits from 31st August to 9th September, 1874, and early next year Sir William Macleay, the greatest Australian benefactor of natural history, fitted out the "Chevert", which went up the Queensland coast and across to New Guinea. It had on board the best collectors available—Masters, Petterd, Brazier and Spalding, a very fine quartette, and their collections must have been immense. At any rate Brazier listed the Gastropoda and recorded over six hundred species; for some reason now unknown the remainder of the molluscan collection was not worked out, and unfortunately has since been dispersed. The collecting places touched at, as every place was a collecting station to the above set of enthusiasts, were Percy Isles, Palm Isles, Brooke Island, North Barnard Island, Fitzroy Island, Low Isles, Howick Group, Flinders Group, Cape Grenville, Cape York, Darnley Island and across to Katow and Hall Sound, New Guinea. Low Isles was called at on 6th June, 1875, but the species recorded by Brazier appear to have been uncommon ones only. Simultaneously a German exploring vessel, the "Gazelle", called at Moreton Bay and dredged outside, but only a few molluscs were recorded.

Then in 1879 Haswell and Morton, on behalf of the Australian Museum, collected about Port Denison and at Holbourne Island, but there is no record of the mollusca secured, though both were excellent collectors. About the same time one of the best Australian conchologists, Tenison-Woods, went up the coast as far as Port Douglas and visited Low Isles, being especially interested in the ecological study of the seashore. His essay is very interesting, especially in view of present-day research.

Then another British surveying vessel, the "Alert", explored the Australian coast

from Sydney northwards. At Sydney, Haswell was taken on board, and with Coppinger, the surgeon-naturalist, collections were made at most of their stopping-places. These were Port Curtis, where dredging was carried out, Percy Isles, Port Molle, more dredging, then to Lizard Island and to Flinders Island and through the Claremont Group (again dredging) into Torres Straits, where four months were occupied, collecting and dredging.

Then Haddon came out to Torres Straits and made a fine conchological collection, and later Melvill and Standen listed no less than 440 (four hundred and forty) species; while from the whole of Queensland, with four months in Torres Straits, only one hundred and eighty species (180) were included in the report of the zoological collections of the "Alert". This appears to be a good instance of the difference of collectors and collecting, as probably Coppinger only included living specimens, while Haddon collected every shell of appreciable size. This is noted, as a collector to-day would probably get well over a thousand species in the same time, but many would be of small size, which would not appeal to Coppinger or Haddon. A good zoologist, dealing with economical matters, was Saville-Kent, whose magnificent work on the Great Barrier Reef is deservedly a classic, but whose photographs of Low Woody Isle do not represent our Low Isles, but an islet nearer Lizard Island. This is mentioned, as in some places the photographs have been assigned to our Low Isles, which have also been called Low Woody Isle. Little regarding mollusca was mentioned by Saville-Kent, but good information regarding Oysters and Pearl Oysters will be found in his work.

The German, Semon, collected in Torres Straits in 1892, and the American, Agassiz, patrolled the Reef in April–May, 1896, while the Englishman, Pace, was three years, 1897–99, in Torres Straits, in the pay of a pearling company, but his results were negligible. Then for a quarter of a century, from 1901 to 1926, the great conchologist, Hedley, worked hard at the problems and conchology of the Great Barrier Reef. He visited most of the mainland islands and was the first to explore the Reef with Australian companions. Three main points were well studied, the Capricorn Group in the south, Hope Islands in the middle and Murray Island in the north. In addition many other points were touched at and in every case collections were made, so that about thirty isles were visited. Owing to his great interest in the Reef itself, the mainland as a collecting ground was, to some extent, overlooked, and this now proves the better hunting-ground. Banfield, the Beachcomber, was not a great collector, so that Dunk Island has not yet revealed its wealth, the few shells pictured by Banfield instigating inquiry. Since Hedley's time, the last ten years have been very fruitful as regards conchological investigation of Queensland waters. At Mr. Hedley's request, Mr. G. P. Whitley and myself visited Michaelmas Cay, off Cairns, while the Reef-boring party under Hedley's direction was working. While not ideal from the viewpoint of comfort, Michaelmas Cay served as an introduction to a purely coral-reef fauna, there being no mangrove association to obscure the grouping of the animal forms in connection with the living and dead coral. Since then Mr. G. P. Whitley, the ichthyologist of the Australian Museum, has visited the Reef again and again (he had previously been to North-West Isle, Capricorn Group and Lord Howe Island), and has always made collections of shells for me. Further, he has been to West Australia, and to Rarotonga and even to Middleton and Elizabeth Reefs, north of Lord Howe Island. From every place he has visited he has brought back shells which have proved of scientific value. Another great assistant has been Mr. Melbourne Ward, the world-famed carcinologist, who has travelled widely in pursuit of his favourites, but who has always brought

back many valuable shells. His latest exploit was the sojourn of a year on Lindeman Island, where he made excellent collections, dredging extensively, as well as shore collecting and studying ecologically the crustacea and their neighbours. I will record specimens collected by Ward from many localities during the course of this essay.

Popular trips have recently been made to parts of Queensland, such as Hayman Island, in the Whitsunday Group (north of Lindeman Island) and to the Capricorn Group (Heron and North-West Isles). Specimens have been brought back from these trips, while on the mainland Mr. H. Bernhard, of Rockhampton, has collected assiduously in Keppel Bay and on the Keppel Isles, giving a good idea of the mainland forms as contra-distinctive to a collection such as that made at Michaelmas Cay.

Thus we have a list of over fifty different localities which have been visited by shell-collectors in recent years as follows, reading from south to north: Coolangatta, many places in Moreton Bay, Caloundra, Sandy Cape, Yeppoon, Keppel Bay, Keppel Isles, Port Curtis, Capricorn Group, Broad Sound, Mackay, Seaforth, Port Newry, Lindeman Island, Port Molle, Hayman Island, Edgecumbe Bay, Bowen, Cape Upstart, Cape Cleveland, Townsville, Magnetic Island, Palm Island, Dunk Island, Barnard Isles, Innisfail, Fitzroy Island, Michaelmas Cay, Green Island, Cairns, Port Douglas, Daintree River mouth, Low Isles, Batt Reef, Pixie Reef, Ruby Reef, Yonge Reef, Snapper Island, Hope Island, Cooktown, Cape Bedford, Three Isles, Two Isles, Rocky Island, St. Crispin Reef, Direction Island, Lizard Island, Eagle Island, Howick Group, Flinders Group, Cape Grenville, Cape York, Albany Passage, Friday Island, Murray Island, Darnley Island and Raine's Island. It will be seen that this list covers the whole extent, but we do not know a great deal about the distribution of the fauna yet. We have learned one important feature, which has already assisted in the determination of species, and that is the *essential* distinction between the molluscan fauna of the shores of the mainland and that of the coral reefs, however near these may be. And further, that the mainland forms are closely related, even at a distance of a thousand and more miles. This discovery will be treated of in detail hereafter, as it is a very important one and must be emphasized. While the collection made at Low Isles is the basis of this Report, all the collections available from Queensland have been criticized, and in order to elucidate problems arising during this review localities have been revisited and further series secured. In the matter of extralimital distribution, collections, made in recent years, are in hand from North-West Australia, New Guinea, Vanikoro, Lord Howe and Norfolk Islands, New Caledonia, Rarotonga, and earlier collections from the South Sea Islands are in this Museum.

LOW ISLES.

Though a description of this locality has been given elsewhere, a short account is given for the benefit of the many conchological readers to whom the general account will be unavailable.

The Great Barrier Reef extends over one thousand miles, very roughly paralleling the coast of Queensland. From Torres Straits to Lizard Island the reef is rather close to the shore, and many islands of mainland origin occur in this northern sector. Apparently many coral reefs as well as fringing reefs are also common, but the fauna of this sector is not well known. Many collections have been made in Torres Straits and it is improbable

that there will be any distinction seen from this well-known area. From Lizard Island to Fitzroy Island is the mid-sector of the reef, and here, while one or two small mainland islets, such as Snapper Island and Double Island, are noticeable, the notable feature is the presence of the pseudo-atolls of the type of Low Isles, such as Two Isles, Three Isles, Hope Isles and Green Island. The northern outpost, Lizard Island, is an elevated mainland island at some distance from the coast, while the southern boundary, Fitzroy Island, is a similar elevated mainland island adjacent to the coast. The intervening isles are all low woody cays, with large reefs adjacent and most with mangrove associations. This mangrove association provides a puzzle to the student, as here we have a mud-living botanical formation coalescing with a mud-hating zoological one. Collections made on such places have entirely masked the distinction between the coral living fauna and the mainland one, as among the mangroves occur forms otherwise restricted to the mainland. On the other hand, jutting-out points of the mainland allow an inferior coral growth with attendant organisms, and collections from such places complicate the matter. Hence the difficulty of determining the present collection so that the truth should become obvious to others as it is known to all local students. To illustrate, Michaelmas Cay was a coral cay in a larger Arlington Reef which was washed by the Trinity Opening, and hence there was no mangrove association. The mainland adjacent was less than twenty miles distant, and the fauna collected there showed so little affinity with that of Michaelmas Cay that out of one hundred kinds less than five were common to the two localities. On the other hand, shore shells from one end of Queensland to the other, say one thousand miles apart, showed little distinction or variety, probably about 5% differing. Mangrove forms are notoriously similar, so that wherever mangroves occur in the Indo-Pacific area the molluscan fauna rarely includes any species indicative of any special locality.

Low Isles lies in the mid-sector of the Great Barrier Reef, being one of a series of similar reefs which range from Lizard Island in the north to Fitzroy Island in the south, the northern sector extending to Torres Straits, and the southern one to the Capricorn and Bunker Groups.

From this mid-sector the first coral reef shells from Eastern Australia reached Europe, as Captain Cook literally touched a reef when he explored the east coast, but he collected no shells on that reef. In this connection attention may be drawn to the variation in size of the reefs and thus also difference in fauna. In 'Banks's Journal' (ed. Hooker, 1896), p. 284, is written : "3rd. The crew of the pinnace had, on their return, landed on a dry reef." In Cook's 'Journal' (ed. Wharton, 1893), p. 285 : "In his return he touched upon one of the Shoals the same as he was upon the first time he was out : he here saw a number of Turtle." One hundred years later Tenison-Woods commented : "Cook relates having found an abundance of turtle on an island reef which is known now as Turtle-reef. It is only at low water springs that any of the reef is laid bare."

It will be noted later that apparently Low Isles has also altered considerably within the same period of time. The islet is composed of drifted sand, with some small patches of coral sand rock reaching up to high-water mark ; this islet was of small extent and was only a few feet above high-water level. As the tide fell a large shallow reef was exposed, almost completely drying at low spring tides ; this reef was to the south and east of the islet, and connected with the larger mangrove islet which lay to the westward and between its northern end and the islet ran a deep channel, forming the anchorage. On the north side of the islet a narrow reef was exposed at low tides. The edge of the reef consisted of

a subcircular ridge of dead coral fragments, beyond which deep water prevailed. Between the Lagoon flat and the Rampart, as the reef-edge was called, was a shallow, always wet portion known as the Moat. Along the outer edge of the Rampart were found huge dead coral blocks, known throughout Queensland as Nigger Heads. As this name was introduced by Flinders for the Australian coral blocks, it should be maintained in this connection, and other names found for other objects.

Three Isles provided a very similar lagoon flat, islet and mangrove association, but here a third mangrove islet had been formed on the south-east edge of the reef-edge. Hope Islands and Two Isles have been described as of like formation.

Michaelmas Cay, to the south of Low Isles, presented only the sandy islet upon which trees had not yet developed nor the reef-edge raised to a height so that the enclosed reef dried regularly, neither had a mangrove association appeared, though it may in the future. Though at first sight Michaelmas Cay appeared different from Low Isles essentially, the distinctions appear to be due to youth only. It is suggested as a working proposition that with age the cay will become covered with trees, the edge of the reef will hold the shingle and form a bank, the lagoon will fill up, and the dead reef on the south-west may become mangrove-bearing, and then the comparison with Low Isles, Three Isles, etc., will be complete.

Green Island is wooded and the lagoon is even drier, but there are no mangroves—a remarkable feature, as mangroves abound on the nearest mainland, only a few miles distant. The nigger heads on the reef edge are more exposed than on the first-named isles.

A flying visit to Pixie Reef showed the first beginning of the islet—just a mound of rolled coral at the north-east point of the reef, which was only uncovered at low spring tides and had not formed a reef-edge.

For comparison North-West Isle in the Capricorn Group was visited, and here a larger well-wooded islet was seen similarly placed, with a larger lagoon flat, which did not dry up so much and the reef-edge, though well defined, was formed of consolidated coral pieces, a few nigger heads being present. There are, however, in the Group no mangrove associations, though there are several similar islets of various sizes. Consequently there is not the complication here with the mangrove fauna, and the fauna is more purely a coral one. In the northern sector, off Low Isles, Batt Reef had been visited, and there no mangroves had yet appeared, even as no islet had been formed, but the reef-edge was marked by nigger heads, and the lagoon was filling up, but not entirely dry, even at low spring tides.

These are all low islets, with no obvious land base and definite coral reefs, though mangroves live in conjunction with some of them.

Along the coast of Queensland a series of high islands occurs ; these have obviously been comparatively recently part of the mainland, and most of these have fringing reefs in their bays and coves. These characterize the third or southern sector of the Great Barrier Reef and popular opinion is that they are part of it. Outside these, however, is the reef proper, a wide space of submerged reefs, very few drying even at low tide and none bearing woody islets. These end in the Swain Reefs, and this sector is practically untouched. To the southward lie the Capricorn and Bunker Groups, a series of low, woody islets like those of the mid-sector, but without any mangrove associations. Consequently the fauna here is a true coral reef fauna, and study of this first revealed the great distinction

of the mainland and coral faunas. It was in connection with the crustacea collected at Port Curtis and at the Capricorn Groups that Grant and McCulloch first recorded the extraordinary dissonance of the two series.

It is worthy of record that Low Isles has become the site of this investigation, as its known history has already shown variation, and the future may show still more. Captain Cook in his ' Journal ' (ed. Wharton, 1893), p. 274, wrote : " At 11 we hauld off N., in order to get without a Small Low Island which lay about 2 Leagues from the Main; it being about high water, about the time we passed it, great part of it lay under water." This was on 10th June, 1770, and on 24th June, 1819, Captain King wrote (' Narr. Survey Coasts Austr. ', I, p. 207, 1826) : " At noon, our latitude was 16° 28′ 48″, and three small islands were in sight a-head, which we passed to seaward of. They are laid down by Captain Cook as one island, whereas they are distinctly three, but all connected by a reef which was covered when we passed."

On 7th July, 1848, the " ' Rattlesnake ' anchored to leeward of the Low Isles. . . This small group may be said to consist of three islets. One is low, sandy, and well wooded, about 300 yards in diameter, and is situated at the north-west extremity of a horse-shoe reef, with its concavity to leeward ; the other two may be looked upon as merely groves of mangroves on the reef, the roots of which are washed at high water, except in a few places, where narrow ridges of dead coral have afforded footing for the growth of a samphire-looking plant (*Salicornia indica*) ".

The extracts indicate the alterations in the physiography of the group in a comparatively short time, and with these superficial alterations changes have occurred in the distribution of the fauna. Undoubtedly throughout Australia in the century and a half since the arrival of Europeans changes in the fauna have taken place through the advance of civilization alone, but in this case there appears to have been changes through natural causes alone. The item which emphasizes this most clearly is the following note : " legions of *Mycteris subverrucata* traverse the sands at low water." This is a little blue crab which is sociable and gregarious, and is not edible ; it has persisted throughout Australia quite close to communities, only disappearing when its habitat is destroyed, yet it has disappeared entirely from Low Isles. A brief account of the Mollusca does not agree closely with the present status, and this might have been ignored were it not for the above confirmation with such a remarkable example.

Tenison-Woods also wrote about the life of Low Isles, but did not mention the crustacea. Later Paradice and Hedley both visited the Low Isles, but left no detailed observations.

AUSTRALIAN MARINE ZOOLOGICAL REGIONS.

Into the study of zoology must now enter geographical accuracy—a factor practically ignored until quite recent years. In connection with Australian zoology all workers have been impressed with the observed differences in the nature of the fauna in the north and south, and have noted that it was not all due to the temperature and conditions arising therefrom, but from a deeper basis. In his report on the Echinodermata collected on the voyage of H.M.S. "Alert", F. Jeffrey Bell wrote (p. 174): The majority of extra-Australian naturalists have as yet failed a little in recognizing the lesson which these collections bring so prominently forward—a lesson already being learnt by those who have

the best opportunities of examining the characters of the Australian fauna ; the term *Australian*, without definition or limitation, affords no exact information." This should be printed in large capitals, as fifty years have elapsed and the lesson has not yet been acknowledged by most extra-Australians, though Hedley, as regards conchology, urged the lesson almost every time he wrote. Further, in order to clarify the matter he indicated the distinctions by means of names, and these, as proposed (' Proc. Linn. Soc. N.S.W.', 1903, pp. 876–883, 28th April, 1904), are still used with emendations ; thus : " The marine fauna which extends from Melbourne along the south coast of Australia . . . I now propose to distinguish as the Adelaidean Fauna. The marine fauna of the east coast of Tasmania, Gippsland, and New South Wales I propose to call the Peronian Fauna.

. . . I take this opportunity of adding the Dampierian for the marine fauna which extends from Torres Straits to Houtman's Abrolhos; and the Solanderian for the marine fauna of the Queensland coast from Moreton Bay to Torres Strait." In a footnote Hedley pointed out that Tenison-Woods had previously introduced the name " Adelaidean " for a zoological subprovince, and that the two were different. Cotton has since emended the nomination by introducing " Flindersian " in place of " Adelaidean ", and this name is most acceptable to all Australian students. Another slight emendation was the separation of the East Tasmanian area under the name "Maugean". Whitley crystallized the data in a short note, accompanied by a map (' Austr. Naturalist ', VIII, pp. 166–167, 8th December, 1932) whereon he added the name "Banksian" for the mainland Queensland area, restricting "Solanderian" to the Great Barrier Reef. All the studies in every group by Australian workers have confirmed the above.

DREDGING STATIONS.

While I was at Low Isles Dr. Yonge initiated several dredging excursions around the island for my especial benefit, with excellent results. All specimens were sorted out of

mud and muddy sand by myself with the help of the dredging party at the time, and the depths ranged from about nine to twelve fathoms. These are recorded as "Low Isles 9–12 fathoms".

Before and afterwards dredging was undertaken at various places visited by the members of the party at different times, and twenty-eight stations were recorded, as follows:

Station.	Locality.	Depth in fathoms.
I.	Linden Bank	20
II.	,,	28
III.	,,	28
IV.	,,	38
V.	,,	37
VI.	Off Linden Bank	114
VII.	,, ,,	114
VIII.	One mile and a half N.W. of Low Isles	11
IX.	Penguin Channel	12–14
X.	Across Satellite Reef	14–17
XI.	Inside Wentworth Reef	7
XII.	Penguin Channel	10–15½
XIII.	Half mile W. of Two Isles	16½
XIV.	,, S.E. of Lizard Isle	19
XV.	,, outside Cook's Passage	210
XVI.	,, W. of North Direction Isle	20
XVII.	Quarter mile N. of North Direction Isle	19
XVIII.	Half mile S.E. of Lizard Isle	20
XIX.	,, N. of Eagle Isle	10
XX.	Quarter mile N. of Eagle Isle	6
XXI.	Half mile N.W. of Howick Isle	10
XXII.	East of Snake Reef	13½
XXIII.	Lee of Turtle Island	8
XXIV.	Three-quarters mile of N.E. Pasco Reef	16½
XXV.	In Penguin Pass	20–25
XXVI.	Papuan Pass—dredge lost	7
XXVII.	Papuan Pass	17
Z.	Quarter mile S. of Cape Kimberley	4

From some of these stations no material was received, and from others only a few hand-picked shells; but from Station VIII some shells and and grit were forwarded, but this merely confirmed the material already secured, as noted above. At the end of the account the shells will be listed under the names here propounded; such lists have been drawn up with tentative nomination, but it would be unwise to publish these at this stage.

SYSTEMATICS.

Before dealing with the systematic portion of this account one or two points must be explained.

An attempt has been made to fix the name that has the best claim, but under the

existing circumstances this is not exactly easy. The International Rules are very clear to anyone who studies them, but in recent years many attempts have been made to read into them novel meanings, with the result that contradictory opinions are issued by the International Commission on Zoological Nomenclature.

A popular method of treatment at present entails the usage of a nondescript genus with many subgenera, and a specific name with a long synonymy and a worldwide distribution, which is definitely incorrect according to Australian material. Most of these so-called genera can be easily shown to be polyphyletic, and under one specific name three or four species have been found to occur. Consequently it has been a long task attempting to reconcile the recorded species with the ones in hand, but the method here adopted will allow easy determination, if the material compared be only duly contrasted with types or carefully criticized topotypical specimens.

In the determination of the better-known species the exact relationship of the Linnean form has been, as anticipated, a source of trouble. Many years ago Hanley devoted himself to the elucidation of the Linnean shells, but unfortunately the correlation was with the twelfth edition, not the tenth, which we use to-day. Consequently each species has to be considered afresh, and as many of them were based on Rumph's Amboina shells, it would appear that the Linnean name might strictly apply to North Australian species. This was at first implicitly accepted, but later it was found that there were two species in Queensland which would answer generally to the Linnean meagre description. and cited figure. Martens gave a reconciliation with the Rumphian species, but at that time there was not the extreme accuracy now demanded, and thus in most puzzling cases the problem is still unsolved. If a study of topotypical specimens from Amboina were carried out, and the habitat and station of the shell examined carefully noted, it might later be possible to allot most of the Linnean names with certainty, but until that work is undertaken there must always be a degree of uncertainty, and the Linnean names are used throughout this essay with reserve and their acceptance will later need revision if facts be produced.

Quite recently a great deal has been written about " nomenclature " by writers such as Woodring, Stewart, Grant and Gale, and Cox, in connection with palaeontological studies. As their outlook was encompassed by dead remains it was practically impossible for them to revivify such and consequently they were compelled to treat their specimens as the dead skeletons they were. All their conclusions are thus bound up with their material, *and are unacceptable without confirmation* by any student of living animals. Groups which by these workers from dead material are rejected, subordinated, or ignored, are in real life distinct recognizable entities unmistakable and definable. The groups have usually a definite station in life and well-marked natural features of differentiation, but such are unknown to the palaeontologist. That great worker, Dall, whom most of the above-mentioned follow, was also a malacologist of the first rank, and he always emphasized these points, and was agreeable to correction of palaeontological conclusions by the better informed conchological worker. It must be admitted, in connection with the study of recent mollusca, that the animal must be considered important, but also, when possible, due attention must be paid to the apparent ancestry indicated by fossils of the adjoining locality.

Dall ('Trans. Wagner Free Inst. Sci. Philad.', III, p. 614, 1898) wrote : " Before proceeding to describe the species collected it is necessary to review the nomenclature

and settle on the characters of the subdivisions to be adopted. This has been a work of considerable labor; the inaccuracy of the diagnostic characters given in the text-books is so astonishing, when they are compared with a series of the species, that one is tempted to believe such diagnoses are written without any reference to specimens, or, at best, with only a single specimen for comparison." Dall then prepared full definitions, and these have since been copied by American workers without emendation, though Dall himself acknowledged that many of his definitions were necessarily based on imperfect material and needed reconsideration. Dall was dealing with fossil material, and for the purpose of exact comparison of recent forms to-day even more labour is necessary. Series have to be examined and the differences (if any) relegated to their correct value, as they may be individual or colonial, geographic or ecologic, and these variations are of different import. Thus series may be collected within a few miles of each other showing great distinction, which local knowledge reduces to its exact value, the governing causes of the variation being explicable by the local student.

In connection with each generic name the genotype is cited, *and its method of determination given*, the nomination of such types being that provided by Starr Jordan ('Genera Fishes', II, p. 165, July, 1919), as follows:

Haplotype: Type by monotypy.
Orthotype: Type by original designation.
Tautotype: Type by tautonymy.
Logotype: Type by subsequent designation.

It is obvious that the last-mentioned is the only method that can trouble us, and undoubtedly there will be much difficulty for some time, but present-day workers, by continually citing the method of selection and in the last case the designator's name and date will soon get over most of the difficulties. In order to assist, Kennard and Woodward ('Proc. Mal. Soc. (Lond.)', XV, pp. 47–51, 1922) prepared a chronological list of recognized workers, and this has aroused interest, and several dubious "designators" have been added to the list. These come into discussion hereafter.

PHYLUM MOLLUSCA.

Somewhat diverse shell-bearing animals are included in this Phylum, so that division into distinct Classes is imperative. No accurate diagnosis of the Phylum is possible because there is variation in every case, *e. g.* there are many animals which have given up their original shell covering, yet they are undoubtedly molluscs. There are some animals with shells almost indistinguishable from those of true molluscs, but which belong to a different Phylum.

The Phylum includes five subclasses: Pelecypoda or Bivalve molluscs; Cephalopoda or Squid-like animals; Amphineura or Coat-of-Mail Shells; Gastropoda or Univalve Molluscs; and Scaphopoda or Tooth-shells. These have been admitted from the beginning of systematics, the chief emendation of systems a century old being the elimination of a sixth Class, the Pteropoda, the members being now recognized as merely specialized Gastropoda.

Class PELECYPODA or LAMELLIBRANCHIA.

Neither name seems really appropriate, the former being the older and practically equivalent. Its subdivision by means of the gill-structure allows such groups as Filibranchiata, where very unlike molluscs come together, and this has been condemned by Davies. Study of hinge-progress, such as carried out by the brilliant Bernard, would probably assist in the correction of many anomalies, but it must be remembered that Bernard's studies can only be regarded as experimental, and there is much more to be done before any valuable conclusions can be accepted. Thus Bernard's divisions are as untrustworthy as any of the many schemes yet proposed. There is no doubt the investigation of hinge-growth will assist, but it cannot be utilized as a basis. In order to arrange the present collection, a review of the propositions had to be undertaken, and this was found to be of comparative value, the various methods of approach leading to very similar conclusions. A short review of the suggestions offered during the past fifty years is given here, as it is necessary to understand the steps whereby the schemes at present in use have evolved, and the discrepancies that need emendation.

For a century and a quarter after Linné the grouping of the bivalves was a matter of conjecture and we find the guesses approximating towards the truth, so that when Neumayr in 1883 proposed a novel classification based on the features of the hinge his results were not revolutionary but rather confirmatory. From that date Neumayr's scheme has dominated the whole study, the very latest account of bivalves being based on Neumayr with comparatively little emendation.

In order to appreciate the present state of our knowledge it is necessary to review the steps since Neumayr's proposals. Neumayr was a great palaeontologist, and his scheme separated the bivalves into five orders, based on the character of the hinges. Previously systems had accepted the length and presence of siphons as essential differences, the presence or absence of adductor muscle scars being otherwise utilized.

Neumayr's five orders were Palaeoconchae or Cryptodonta, Desmodonta, Taxodonta, Heterodonta and Anisomyaria or Dysodonta. The first-named included the Palaeozoic fossils, which had apparently thin shells and almost toothless hinges, while there were two equal muscle impressions and an entire pallial line. An Order Desmodonta was introduced for those molluscs with the ligament internal and interposed between the teeth, with the pallial line sinuated. This covered the families Pholadomyidae, Corbulidae, Myidae, Anatinidae (= *Laternulidae* hodie), Mactridae, Paphiidae (= *Amphidesmatidae* hodie), Glycymeridae (= *Panopeidae* hodie), questionably the Solenidae and the "Tubicolae" of Lamarck (*i. e.* Clavagella, etc.). Then he proposed the Order Taxodonta to include the families Arcidae and Nuculidae, the forms having the hinge line long, the teeth numerous and little differentiated, muscle impressions equal, pallial line apparently complete. The bulk of the bivalves then fell into the Order Heterodonta, the shells having few teeth, separate and interlocking, the pallial line variable, the ligament also variable and the muscle impressions subequal, but inconstant in form. This left the species with aberrant muscle impressions, some with one only, but others with two, one very large, the other very small; the hinge line showing no teeth or only minute ones and a more or less entire pallial line. These were classed as an Order Anisomyaria or Dysodonta, the series being subdivided into two sections, the Heteromyaria to include the families Aviculidae,

Mytilidae, Prasinidae and Pinnidae; the Monomyaria for the Pectinidae, Spondylidae, Anomiidae and Ostreidae.

Obviously there was a possibility of emendation in many directions as the associations, though better than the previous ones, were not beyond criticism. It was at once suggested that the necessary alterations might be brought about by study of the animals, especially the gills. This was suggested by Lankester, as differences in the constitution of the gills had been pointed out more than thirty years before. Pelseneer therefore studied this character and proposed a new classification based entirely upon gill-structure. This, in general, agreed with the conclusions arrived at by criticism of shell features, such as hinge, pallial line and muscle scars. It moreover appeared to dispose of some anomalous results, though perhaps introducing others almost as irreconcilable. Pelseneer's account appeared in 1889 and admitted five Orders based entirely on the form of the gills, Protobranchiata, Filibranchiata, Pseudolamellibranchiata, Eulamellibranchiata and Septibranchiata. As always, classifications based upon intangible features appeal to the ignorant, and hence conchologists, unable to criticize such a scheme, accepted it greedily. Yet the associations arrived at in this case were not better, but rather worse, than the old ones utilized from study of the shells alone. Nevertheless, when the great conchologist, palaeontologist and malacologist, Dall, reported upon it he indicated the unstable nature of the conclusions achieved by gill study alone, and therefore suggested, in 1895, a reconsideration of the Neumayr and Pelseneer schemes, combining the best in each, and providing an excellent basis for future work. It must be remembered that Pelseneer's classification was based on gill-structure alone, the shell characters being ignored.

At the same time Bernard began his studies on the development of the hinge, and here again apparently revolutionary proposals made little difference to the structure so well known. By means of his knowledge Bernard was suggesting the reduction of divisions to two, and then death intervened. What Bernard would have determined with fuller study will never be known, but his tentative suggestions need careful consideration.

In 1889 Dall produced an excellent essay on the development of the hinge, and subdivided the Pelecypoda in accordance with the data achieved by this study. This thoughtful account was based on malacological knowledge, supported by conchological information, and was thus more advanced than Neumayr's essay formed from shell study alone. He averred that there could be only three fundamental types of hinge, which he termed "anodont", "prionodont" and "orthodont". For the group in which he recognized an archaic anodontism as a persistent character he introduced the name "Anomalodesmacea". Then he provided the name "Prionodesmacea" for the forms in which the transverse plication of the hinge is the chief characteristic, and the remainder showing the highest and evolutionally the most perfect in type of hinge were grouped together as Teleodesmacea. These groups were separated as Orders and the only groups of primary value. For example Dall cited pearliness as a source of weakness, and proclaimed that the tendency of evolution was to promote the porcellaneous type. This he confirmed by the inclusion in the Prionodesmacea and Anomalodesmacea of all pearly bivalves, and noted that there was not a single pearly one among the Teleodesmacea.

A result very similar to that of Pelseneer had been recorded by Ménégaux, who studied the gill-structure independently and simultaneously, and whose main difference

from Pelseneer was in the abolition of the Pseudolamellibranchiata, which he included in the Filibranchiata. Ménégaux also provided the name "Foliobranches" (= Foliobranchiata) instead of Protobranchia as being more descriptive. Thus it can be seen that there was divergence at the very beginning as to the value of the variation seen in the gill-structure. Next Ridewood made a careful study of the gills from a different viewpoint and showed clearly the futility of depending upon this character alone. In order to bring this matter clearly before systematists he arranged the bivalves solely by means of this larger knowledge of the gills and gave a new classification, which he stated was of little absolute value. He still allowed the Protobranchia, but separated all the remainder into two Orders, which he called Eleutherorhabda and Synaptorhabda. In the Eleutherorhabda he allowed three Suborders, Dimyacea, Mytilacea and Pectinacea. The Dimyacea was proposed for the Dimyidae alone, a rare little deep-water form about which little was known, save that it looked like a dimyarian oyster. The Mytilacea comprised such diverse elements as Anomiidae, Arcidae, Trigoniidae, Mytilidae, Melinidae and Amussiidae, while the Pectinacea covers the Spondylidae, Pectinidae and Aviculidae. By means of the gill-formation he was enabled to separate one species of *Anomia*, viz., *aculeata*, from the others and place it in a different suborder. (Winckworth has since provided a genus *Heteranomia* for *aculeata*, to which Thiele allows only subgeneric rank.) Further he placed the Amusioid shells in a different Suborder from the Pectens, but associated with the Amusioids in the same family the genus *Plicatula*. The Limidae he transferred to the next Order along with the Pinnas and Oysters, which he formed into a Suborder Ostraeacea. Then apparently realizing the futility of any further subdivision on these lines he simply left the remainder in the Pelseneerian order, with the abolition of the Order Septibranchia, relegating these members to a Suborder only. In his essay Ridewood referred to the work of Dall, probably upon Smith's initiative, as being worthy of full consideration on account of the scientific standing of the author. It must be again recalled that Ridewood had no knowledge of molluscan shells, but fortunately his material was named by E. A. Smith of the British Museum and thus the identifications can be relied upon.

In 1906 Pelseneer issued an emended classification accepting some of Ridewood's conclusions, and this is the latest to utilize branchial structure alone. Then four Orders were admitted, Protobranchia, Filibranchia, Eulamellibranchia and Septibranchia. The Pseudolamellibranchia, following Ridewood's suggestions, was abolished, and the forms distributed according to Ridewood's advice. The Order Septibranchia, which Ridewood had also abolished, was, however, retained.

In 1909 a very important contribution was made by Cossmann and Peyrot, the senior author being really alone responsible. This enthusiastic palaeontologist objected to some of Dall's statements and utilized more the Neumayr scheme, but with emendations on all the previous accounts. They arranged the Pelecypoda into three Orders alone, but with Suborders and many "Cénacles" or Superfamilies. In 1914 they admitted that the arrangement should be reversed. The Order Eulamellibranchiata, included, as usual, the majority of bivalve molluscs, but was divided into seven Suborders—Anomalodesmata, Adapedonta, Desmodonta, Hemiadapedonta, Heterodonta, Schizodonta and Palaeoconcha. Then followed the Order Taxodonta with two Suborders, Foliobranchiata and Filibranchiata, and the Order Anisomyaria with two Suborders, Subfilibranchiata and Pseudolamellibranchiata.

Pelseneer ('Siboga-Expedite', Mon. LIII*a*, pp. 1–126, 1911) drew up an evolutionary tree suggesting the development of the Lamellibranchia from the Protobranchia through the Filibranchia and Pseudolamellibranchia to the Eulamellibranchia, showing the Septibranchia as the last stage. Of these series the Eulamellibranchia include the great majority of bivalve mollusca and the various suggested relationships are shown graphically. At the very foot of the tree is ranged the Protobranchia, including only the Solemyidae, the Nuculidae and the Nuculanidae (Ledidae of Pelseneer); the former is shown as an offshoot below the Nuculidae and without any relations of higher rank. The Nuculanidae are developed directly from the Nuculidae and apparently include all the small similar taxodont shells. Then apparently from a Nuculid source all the Filibranchia appear to arise—a result certainly unanticipated from study of shell structure. The somewhat heterogeneous assemblage regarded as Filibranchia does not invite confidence in this mode of classification. Thus from this Nuculid basis two arms stretch out in opposite directions, one to the Anomiidae, from which a lead goes forward through the Mytilidae into the Eulamellibranchia, the other through the Glycymeridae (Pectunculidae of Pelseneer) and Arcidae to the Philobryidae, with an offshoot to the Dimyidae.

Then on the way to the Eulamellibranchia, the complete bivalves, a series called the Pseudolamellibranchia intervenes. This series comprises the Ostreidae, the Aviculacea and the Pectinacea. This is certainly a fairly homogeneous association, whatever its exact location may be.

As all the remainder of the bivalves come under the group Eulamellibranchia, save the Septibranchia, which are regarded as a specialized group of high value, a variety of interrelationships can be easily devised. Thus the basic position is allotted to the Astartidae, as a *cul-de-sac* representing the Crassatellidae, a branch in the opposite direction being granted to the Lucinid evolution. This Lucinid association does not seem natural, as the small Laseid, Leptonid, and Montacutid forms are apparently derived from Lucinid sources—a conclusion incongruous with the habits and conchological features; through the Leptonids appear the Galeommatids continuing to the Chlamydoconchidae.

The other groupings are too complex to review here, but will be mentioned later, and suggestions offered for the emendation of items.

In 1912 March discussed the general classification of the Pelecypoda, but the account was not so much a discussion as an appreciation of Bernard's work. March, somewhat arbitrarily, dismissed gill-classification as " useless taxonomically ", and therefore formulated Bernard's uncompleted scheme, providing technical names of his own invention. Two Orders only were allowed, the Pleurodonta and Heterodonta, the former into two Suborders, Dysodonta and Taxodonta, while the latter was separated into two divisions, Pliodonta and Oligodonta. This was a retrograde movement, as after arranging the few outstanding anomalies as the Mytilidae to the Ostreidae under the Dysodonta, and the multidentate forms as the Taxodonta, all the remainder of the bivalves are classed under the Heterodonta. The location of the Trigoniidae at the end of the Heterodonta needs no discussion.

In 1916 Dall published an emended classification, utilizing Pelseneer's emendations, and further improvements were included in his last publication in 1920. Dall's scheme has been commonly utilized since then by Americans without comment, by Australian workers with reserve, by British workers with a leaven of Pelseneerian ideas, the latest

being Winckworth in his 'List of British Marine Mollusca' in 1932. The following year Davies commented upon "The Bases of Classification of the Lamellibranchia", pointing out that the Pelseneerian Orders were polyphyletic and unnatural.

On the Continent the Neumayr scheme still held sway, as the students were mostly Palaeontologists, and that certainly satisfied their needs much better than the somewhat futile Pelseneerian characters could do. Hence we find the German malacologist, Thiele 1934, utilizing in his 'Handbuch' a form of Neumayr's innovation, with not a great deal of improvement, although half a century had intervened.

An attempt to evaluate the characters utilized in bivalve classification was made by Douville, who would rank them in three series—adaptative, progressive and static or stable characters. The first-named were of least importance absolutely, and included such features as byssus-bearing, nestling or boring habits, and cementation. In order to appreciate these, however, field knowledge must be utilized, as in some cases the presence or absence of a byssus is of little real importance, while in others it is of the greatest value. Gill-structure was regarded as essentially progressive, but here again there may be secondary degeneration and convergence, and little is known of the gill-formation in a comprehensive manner. The hinge was classed as a stable character, especially when used in conjunction with muscle development. Again we have not sufficient information in the latter case to consider it, and no one has studied hinge development through one group alone, from young to adult.

Shell characters, judging form, hinge features and muscle scars are of first-class importance with gill-structure as a valuable aid in adjusting discrepancies, the minor details of byssus bearing and cementation having little consideration in the major groupings. This agrees with our general usage, whether Pelseneer, Ridewood, Dall, Neumayr, Cossmann and Peyrot or Thiele be accepted.

A glance over the list of contributors to the Pelecypod complex indicates that no working conchologist save Dall has studied the matter. The names in chronological order read: Neumayr 1883, Lankester 1884, Pelseneer 1889–1906–1911, Ménégaux 1889, Dall 1889–1895–1901–1916–1920, Jackson 1890, Suess 1891, Grobben 1892, Rice 1892, Bernard 1895–8, Vest 1901, Ridewood 1901, Cossmann and Peyrot 1909, Douville 1912, March 1912, Winckworth 1932, Davies 1933 and Thiele 1934. There are many palaeontologists—Neumayr, Dall, Jackson, Suess, Grobben, Cossmann and Peyrot, Douville, March and Davies. The others are anatomists as Lankester, Pelseneer, Ménégaux, Bernard, Ridewood and Thiele. In the latter series most of these workers were unfamiliar with conchological study, and thus unable to follow up their anatomical results.

From analysis of the foregoing schemes in connection with a mass of material the following arrangement has been prepared, and support is seen in the preceding for all the emendations :

Class PELECYPODA.

(LAMELLIBRANCHIA, BIVALVIA, ACEPHALA.)

Subclass PRIONODESMACEA.
ANOMALODESMACEA.
TELEODESMACEA.

Subclass PRIONODESMACEA.

Order PALAEOBRANCHIA. (LIPODONTA.)
PROTOBRANCHIA. (FOLIOBRANCHIA.)
FILIBRANCHIA. (TAXODONTA.)
PALAEOLAMELLIBRANCHIA. (SCHIZODONTA.)
PSEUDOLAMELLIBRANCHIA.
PARAFILIBRANCHIA.
ISOFILIBRANCHIA.

Order PALAEOBRANCHIA.

(LIPODONTA.)

Family SOLEMYIDAE.

Order PROTOBRANCHIA.

(FOLIOBRANCHIA.)

Family NUCULIDAE.
MALLETIIDAE.
NUCULANIDAE.

Order FILIBRANCHIA.

(TAXODONTA.)

Family LIMOPSIDAE.
ARCIDAE.
GLYCYMERIDAE.

Order PALAEOLAMELLIBRANCHIA.

(SCHIZODONTA.)

Family TRIGONIIDAE.

Order PSEUDOLAMELLIBRANCHIA.

Suborder AVICULIFORMES.

Family PTERIIDAE.
RENIELLIDAE.
ISOGNOMONTIDAE.

Suborder PINNIFORMES.

Family PINNIDAE.
(PHILOBRYIDAE.)

Suborder PECTINIFORMES.
(ISODONTA, HOMOEODONTA.)

Family PECTINIDAE.
AMUSIIDAE.
SPONDYLIDAE.
PLICATULIDAE.
LIMIDAE.

Suborder DIMYIFORMES.

Family DIMYIDAE.

Suborder OSTREIFORMES.

Family OSTREIDAE.

Order PARAFILIBRANCHIA.

Family ANOMIIDAE.
PLACUNIDAE.

Order ISOFILIBRANCHIA.

Family MYTILIDAE.
(DRIESSENIDAE.)
MUSCULIDAE.

Subclass ANOMALODESMACEA.

Order ANOMALOBRANCHIA.
SEPTIBRANCHIA.

Order ANOMALOBRANCHIA.
(ENSIPHONIA.)

Suborder LATERNULIFORMES.

Family LATERNULIDAE.
PERIPLOMATIDAE.
PHOLADOMYIDAE.
THRACIIDAE.
MYOCHAMIDAE.
CLEIDOTHAERIDAE.

Suborder PANDORIFORMES.
(ADELOSIPHONIA pt.)

Family PANDORIDAE.
LYONSIIDAE.

Suborder BRECHITIFORMES.

Family BRECHITIDAE.
(CLAVAGELLIDAE.)

Order SEPTIBRANCHIA.
(ADELOSIPHONIA pt.)

Family VERTICORDIIDAE.
POROMYIDAE.
CUSPIDARIIDAE.

Subclass TELEODESMACEA.
(Under consideration.)

Subclass PRIONODESMACEA.

This is a somewhat heterogeneous assemblage, but as there must be some tentative method of classification it is here used with reservation.

Dall proposed the name for a group which he regarded as an Order, but Winckworth has ranked it as a Subclass, and on account of the factors involved such is here accepted.

The division into Orders is far from satisfactory, because the Solemyid molluscs and the Nuculid molluscs are classed alongside, although they are conchologically and anatomically discordant. Consequently, though both are regarded by some workers as primitive in form, they are separated into two Orders, and *Solemya* is allowed the lowest position with considerable doubt. Then the Filibranchia is just as certainly polyphyletic and is split up, but again a later rearrangement is desirable. Therefore,

instead of Winckworth's usage of Dall's three Orders seven are here defined, one of which is again separated into four Suborders: the Orders are Palaeobranchia (= Family Solemyidae), Protobranchia (less Family Solemyidae), Filibranchia, Palaeolamellibranchia (= Trigoniidae), Pseudolamellibranchia, Parafilibranchia and Isofilibranchia.

Order PALAEOBRANCHIA.

This name is provided for the curious group of world-wide molluscs, typified by *Solemya*, and whose systematic position is at present quite unknown. According to the gill-structure the animals show very primitive features, and thus Dall placed them at the base of the whole Order, but classed them with the Nuculids, with which group they have absolutely no conchological affinity. Thiele has unfortunately included the family Solenomyidae in his Stirps Nuculacea of the Order Taxodonta, an association so incongruous that the name "Taxodonta" becomes meaningless. In this case Cossmann and Peyrot had dissociated these molluscs from the Order Taxodonta, placing them under the Order Eulamellibranchiata with subordinal rank, and the name Palaeoconcha. They allowed a "Cénacle", Solenomyacea, which name is used by Dall for his superfamily. It seems quite inaccurate to use the same ending "-acea" for Orders, and also for super-families, and in other groups the ending "-oidea" is commonly in use for the latter. This "-acea" ending is also used by Thiele for his "Stirps", and was taken from Cossmann and Peyrot's usage for their "Cénacle", although Fischer had used it as a subordinal ending. In this Report the ending "-oidea" will be accepted for the regular formation of superfamily names.

Family Solemyidae.

This anomalous group does not seem to have any claim to the position here allotted, apparently on account of the gill-structure. The latter is probably due to extreme specialization, and is not a remnant of a generalized style as assumed. The edentulous hinge and weak shell contrast greatly with the multidentate hinge and stout shell of its associates elsewhere, the Nuculids, the only resemblance being the simple gill seen in the animals of both these groups. This, however, is of quite a different nature in each case, and is certainly not a sign of any relationship whatever.

Dall ('Nautilus', XXII, p. 1, 1st May, 1908) separated *Solemya* (s.l.) into three groups, as follows:

"*Solemya*: Ligament amphidetic, chiefly internal.

"*Petrasma*: Ligament not exposed internally in front of the chondrophore.

"*Acharax*: Ligament opisthodetic, wholly external."

Under *Solemya*, with type, *australis*, he placed *parkinsonii* from New Zealand, and *solen* = *mediterranea* from the Mediterranean Sea.

Genus *Solemyarina*.

1931. *Solemyarina* Iredale, Rec. Austr. Mus. XVIII, p. 202, 29th June.
Orthotype: *Solemya velesiana* Iredale.

In the large Australian shells (*S. australis*) the internal ligament appears on both sides of a curved thickened rib which crosses the valve in front of the posterior muscle scar; in *S. parkinsonii* Gray the ligament extends posteriorly linearly and is seen as a small

transverse line in front of a rib which divides into two to bound the muscle scar, a distinction which may be regarded temporarily as of subgeneric value, and the name *Zesolemya* is proposed thus for the Neozelanic species.

The small species I separated as *Solemyarina* show a rib formation and ligament structure more like that of the Neozelanic form than that of the large Australian shells. The median rib is not curved, but is angulated posteriorly, while the anterior portion of the ligament is small and linear and the posterior portion is small and sublinear, the posterior muscle scar free.

Solemyarina terraereginae Iredale, 1929.

1929. *Solemya terraereginae* Iredale, Mem. Queensland Mus. IX, p. 262, pl. xxx, fig. 13, 29th June: North Queensland = Green Island.

This little shell has now been collected at various spots from the Capricorn Group to Torres Straits, both at Masthead and North-West Isles in the former group, and at Goode Island in the latter. Similar specimens have been collected at Annam River and Starcke River on the mainland. A couple of specimens were sorted out of Low Isles dredgings, and I saw a living animal secured by Dr. F. S. Manton by sandwashing on the reef. The figured specimen was collected at Green Island, near Cairns.

Order PROTOBRANCHIA.

This is Winckworth's name for the Nuculid molluscs, and is preferred to Dall's Foliobranchiata, in which was included the superfamilies Solenomyacea and Nuculacea. Thiele has regarded these molluscs, associating with them the Solenomyidae, as constituting a Stirps Nuculacea of the Order Taxodonta. The inclusion of the family Solenomyidae cannot be defended from a knowledge of the shells and living animals.

Family NUCULIDAE.

This family includes a large series of small, swollen, "nut-like" shells, with a dark velvety periostracum covering a porcellaneous exterior, while the interior is brightly nacreous. There is an internal resilium situated on an intrusive ledge (called the chondrophore), and the teeth are numerous, long, lance-like, arranged on each side of this chondrophore. The adductor impressions are subcircular, subequal and connected by a simple pallial line, the interior edges of the shell being more or less denticulate. Study of New South Wales specimens advised the separation of the local forms into the genera *Ennucula*, *Deminucula* and *Pronucula*. These groups have been considered in the criticism of the many species secured at Low Isles. Though there is some variation in the Queensland species, which may later necessitate generic segregation, at the present time the majority are allotted to *Ennucula*, one small species being attached to *Pronucula*. When research into minute details, such as has been carried out by H. B. Moore in connection with the British forms, is indulged in here there may be many more species than can be easily diagnosed by means of conchological features alone, especially as there is a notable variation through growth stages.

Since my studies on this group were completed there has been published a "Classification

of Nuculid Pelecypods" by H. G. Schenck ('Bull. Mus. Voy. d'Hist. Nat. Belg.' X, No. 20, pp. 1–78, pls. i–v, June, 1934). The composition of a family is discussed and several other points are raised which are worthy of consideration, such as the non-co-ordination of shell and animal characters in schemes of classification. In this essay conchological features have been stressed as it naturally follows that these show animal differences, and if such conchological distinctions be of long lineage the animal variations must be definitely fixed and of high value. If a conchological feature persist through a series of species or even genera, and through ages, then its lack must be definitely recognized by name. Thus the presence of a chondrophore is regarded as diagnostic of Nuculids, and *Deminucula* is queried by Schenck on account of the absence of the chondrophore being reported to him. Nevertheless, there is a chondrophore present in this genus, but the dead specimens in the British Museum, as many dead shells do, appear to lack this feature. My specimens have been compared with the types and are from practically the same locality and agree in detail with the description and figure, and while some dead shells appear to lack the chondrophore, in the better preserved ones it is present exactly as I described it.

Thiele's family Nuculidae included one genus only, *Nucula,* with four subgenera—*Brevinucula* Thiele, *Lionucula* Quenstedt (= *Ennucula* Iredale), *Acila* H. & A. Adams (with two sections, *Truncacila* and *Acila* s.s.), and *Nucula*. Apparently he concluded that *Pronucula* Hedley was based on juvenile specimens of *Nucula* s.s., and rejected *Deminucula* Iredale as not being different. Such treatment is scarcely worth consideration and incites confusion in every sense. The type of *Lionucula* Quenstedt is the fossil *N. albensis* Orbigny, a Cretaceous French fossil, and obviously has no relation whatever with my Australian living *Ennucula*. *Pronucula* is a very distinct genus and is easily separated from juvenile forms of *Ennucula,* while *Deminucula* is also different. However, without prejudice, Schenck may be quoted as differing entirely from Thiele. Unfortunately, though in the course of excellent work, Schenck has confused under the name *Ennucula obliqua* Lamarck three Australian species, and has not read my papers closely, as he states in connection with *Ennucula,* "No type was designated". If I include more than one species under any generic name I am usually very careful in the matter of type designation, and in this case I made no error, though Schenck has erred, the type being correctly designated in the paper cited.

In the diagnoses of his bivalve groups Dall used amphidetic and opisthodetic to distinguish between the position of the ligament, but these do not seem useful in these groups. Thus, of *Nucula* he wrote "a wholly internal amphidetic resilium", but amphidetic was defined as "extending on both sides of the umbo", and this scarcely applies in this case. He also utilized alivincular for resilium "with long axis transverse to the plane of the valve margins and the axis of motion". Again this does not accurately indicate the nature of the resilium in our Nuculids, where it slopes in a "parivincular" fashion, that is, with the long axis corresponding with the axis of motion or vertical plane between the values. Many workers repeat these long words without inquiry into their meaning, and they should be rejected in a general definition of *Nuculids*. Our groups may be separated thus :

Larger : Teeth rows somewhat angulately in opposition, ligament pit oblique . . . . *Ennucula.*
Smaller : Teeth rows in a curved arch, ligament pit vertical . . *Pronucula.*

Genus *Ennucula*.

1931. *Ennucula* Iredale, Rec. Austr. Mus. XVIII, p. 202, 29th June.
Orthotype: *Nucula obliqua* Lamarck.

The distinguishing characters indicated were the notably oblique chondrophore (ligament pit) with the lessened teeth not notably angulate to the posterior row; the denticulations of the inner margin of the shell are generally obsolete.

The species can be sorted out by means of size and sculpture, and confirmation then made by study of the hinge teeth.

Shell large, solid, teeth strong	*E. superba.*
Shell large, thin, teeth weak:	
Short stout chondrophore	*E. compar.*
Long slender chondrophore	*E. loringi.*
Shell sculptured, thin, teeth strong	*E. definita.*
Shell small, stout, teeth strong	*E. privigna.*
Shell, small, elongate, teeth weak	*E. orekta.*

The last two are easily separable by their shape, but the four preceding do not show much differentiation in shape, though the characters given will easily separate them. When living, the shells are clothed with a thin shining olive periostracum.

Ennucula superba Hedley, 1902. (Plate I, figs. 1 and 1*a*.)

1902. *Nucula superba* Hedley, Austr. Mus. Mem. IV, p. 292, 29th July: Tropical Queensland.
1912. *Nucula superba* Hedley, Rec. Austr. Mus. VIII, p. 131, pl. xl, figs. 1, 2.

Hedley introduced this name for the conspicuous *Nucula* from North Queensland, which had been called *obliqua* Lamarck, a name belonging to a southern Australian species. The only locality mentioned was Palm Islands, but when he later figured his species he selected a specimen from off Cape Sidmouth as type. The Low Isles shells, dredged in 9–12 fathoms, may be regarded as conspecific, as the teeth agree fairly closely, but there is a difference in shape. The characteristics of the species are the short posterior end with the notable impressed lunule, the thick strong teeth, smooth surface and medium deep chondrophore. Growth-lines are sometimes prominent, and when living the shell has a shining olive periostracum. The anterior teeth are long, somewhat triangular and curved, about twenty to twenty-five, half in front of the chondrophore and the remainder decreasing in size very rapidly above it; the posterior series numbers about six, one small and almost parallel to the chondrophore, the others larger and triangular; the whole somewhat angularly opposed to the anterior series. The ventral margin apparently smooth, but microscopically crenulate.

Compared with the type, the Low Isles specimens are more convex, the anterior margin less elevated, and more produced. Specimens however from Roebuck Bay, North-West Australia, show very little variation.

Recently Mr. H. S. Mort has found dead valves in numbers on the beaches of Keppel Bay, and they are all comparatively uniform and large, many over Hedley's size limit, reaching more than 28 mm., the size of the Arafura Sea specimen. Obviously these must have been living in shallow water, and Mr. Melbourne Ward has sent me down a living specimen which he dug out of sand at extreme low water at Lindeman Island. On the

beach at Seaforth, north of Mackay, many valves were collected, and all are stout and in agreement with the shell figured.

Prashad (p. 17, pl. i, figs. 13–16) has described a *Nucula dautzenbergi,* which he compares with *N. obliqua,* but distinguishes it " by its distinctive hinge structure and its fine sculpture ". No details nor figure of the hinge are given, while the external appearance recalls this species.

The shell figured here measures 20·5 mm. in length and 16 mm. in height. Schenck has figured a specimen of this species (pl. iii, fig. 4) from the Arafura Sea, under the name *Ennucula obliqua* Lamarck.

Ennucula loringi A. Adams and Angas, 1864. (Plate I, figs. 4, 4*a.*)

Hedley advised the acceptance (' Proc. Linn. Soc. N.S.W.', XXXVIII, p. 264) of the name *Nucula cumingii* Hinds (' Proc. Zool. Soc. (Lond.)', 1843, p. 97 (December) : New Guinea, etc.) for the species he had listed as *Nucula loringi* A. Adams and Angas (' Proc. Zool. Soc. (Lond.) ', 1863, p. 427, 20th April, 1864 : Keppel Bay, Queensland), figuring the type of the latter. Here again a mainland locality is concerned, and no Low Isles shells agree exactly with the figure given, the specimens, agreeing best in shape, differing in having a notable long chondrophore. They are thin in texture, of medium convexity, the posterior end a little produced, the anterior much elongate and the ventral margin well rounded, the surface smooth superficially, but having fine growth lines and indistinct signs of radials ; the lunule small, impressed. The teeth are very weak, the anterior series short, the teeth small and triangular, about twenty-three in the largest specimen, half in front of the chondrophore and half above it, the chondrophore being elongated ; the posterior series shows seven teeth, three parallel to the chondrophore, the uppermost very small, the other four triangular. Valves collected on the beach at Seaforth, north of Mackay, agree with the Low Isles specimens, and it is suggested that the drawing of the chondrophore in Hedley's figure is not accurate.

Prashad (p. 14) has recorded *N. cumingii* Hinds with a note—"is a large but thin-shelled species. The surface of the shell is smooth, except in full-grown shells, which near the ventral margins show a number of concentric rings of growth ".

In Queensland the species *loringi,* the representative of the Moluccan *cumingii,* does not show " a number of concentric rings of growth ", but a distinct species described hereafter is plicated.

The specimen figured is from Low Isles, and measures 18 mm. in length and 13 mm. in height.

Ennucula compar sp. nov. (Plate I, figs. 2 and 2*a.*)

Confused with *E. superba,* this species differs in its weak teeth. It differs in shape from the type form, but is thinner, less convex, the ventral margin more rounded, the anterior teeth fewer and shorter and the posterior series more crowded. It may be the deeper water form of the Low Isles expression of *superba,* but as the latter, when collected in numbers, has proved to show little variation, it is named as distinct and figured, the specimen coming from Station XXIII, and measuring 20 mm. in length, 16 mm. in height, and 3·5 mm. in depth of single valve.

A larger perfect shell has been received from Hayman Island, which shows a darker coloured periostracum and confirms the distinction.

The anterior teeth number about twenty, between seven and nine being above, the chondrophore being short and stout, the lunule less pronounced and smooth, the posterior teeth being six in number, the first, nearest the chondrophore, being long.

Ennucula definita sp. nov. (Plate I, figs. 3 and 3*a*.)

This species had been named in our collection as "*cumingi*", but it is very distinct in every material item ; the most noticeable feature being the plications at each side, the median area being almost smooth. The posterior end is slightly produced, the anterior elongated, the ventral margin a little convex, the dorsal margin also a little elevated ; the lunule is not very well distinguished and is plicate. The teeth are fairly strong and crowded, the posterior series numbering seven or eight all similarly triangular, and not so angularly contrasting with the anterior series : this is composed of about twenty-five triangular fairly long teeth, only about ten small teeth being above the chondrophore, which is small and shallow.

The specimen figured from Low Isles measures 13·5 mm. in length and 10 mm. in height.

Ennucula privigna sp. nov. (Plate I, figs. 5 and 5*a*.)

This is a very small species, with a short posterior side, a distinct lunule, fairly strong teeth and a small chondrophore. The shell is stout, convex, the posterior side produced, a little angulate, the anterior lengthened, a little convex, the ventral margin well rounded. The surface is smooth, shining, growth lines indistinct (periostracum missing). The hinge line is less angulate and the chondrophore small, the anterior series showing ten teeth, with a couple of small ones above the chondrophore ; the posterior series numbering five, all the teeth short and rather stout.

The figured specimen from Low Isles measures 3·25 mm. in length and 2·5 mm. in height.

Ennucula orekta sp. nov. (Plate I, figs. 6 and 6*a*.)

This curious little species recalls *N. antipodum* Hanley in miniature, the posterior end rather short, almost perpendicular, the anterior elongately sloping, not very convex, the ventral margin rounded. Somewhat convex, the surface is smooth and shining, white (periostracum missing), growth lines little marked. There is a small, rather marked lunule. The teeth are long, thin, peg-like, the anterior series of medium length, the posterior short and almost at a right angle to the anterior ; the posterior teeth number five, the anterior thirteen disappearing above the long slender chondrophore.

The specimen figured is from Albany Passage, Torres Straits, 9–12 fathoms, collected by Mr. Melbourne Ward, and measures 4 mm. in length and 3 mm. in height.

This species has since been collected at various parts of the Queensland coast.

Genus *Pronucula*.

1902. *Pronucula* Hedley, Austr. Mus. Mem. IV, p. 290, 29th July.
Orthotype : *P. decorosa* Hedley.

Hedley placed this genus in the family Nuculidae, noting that the hinge line was arched instead of angulated, and that the teeth did not meet nor overlap beneath the

umbones, and that the chondrophore was perpendicular, not oblique. The radial sculpture is more pronounced than in *Nucula*, and the shape is less trigonal.

Pronucula saltator sp. nov. (Plate I, figs. 10 and 10*a*.)

Shell very small, subtrigonal, posterior side short, rather steep, no lunule, anterior elongated, a little convex. The shell is stout, quite unlike a thin juvenile "*Nucula*". The surface is very finely radiately striate, stronger striae on the posterior side. The hinge line is convex, the chondrophore small and vertical, the teeth rather large and few in number, the posterior series numbering four or five, while the anterior are only eight or nine, all the teeth comparatively stout.

The specimen figured, from Low Isles, measures 1·5 mm. in length and 1·25 mm. in height.

Family NUCULANIDAE.

Although associated with the preceding and constantly stated to be related the texture is usually very different, with the pallial line showing a feeble sinuation. Nearly always the shells are elongate, so that the length is always greater than the height. The interior is porcellaneous, not nacreous, while the shell sometimes gapes posteriorly, all the Nuculids being tightly closed. Mostly living in sandy mud, these bivalves are not uncommonly found in dredgings, though rarely met with upon beaches. Thus Smith described one species in the "Alert" Report, and four more in the "Challenger" Report, and these, with the addition of one southern species, comprised the species of "*Leda*" in Hedley's Queensland List. Four species were common in the dredgings at Low Isles, each representing a distinct group, thus :

Large stout, lirate, long beaked	*Scaeoleda.*
Large, stout, lirate, short beaked	*Eptoleda.*
Small, stout, strongly lirate, short beaked	*Zygonoleda.*
Small, thin, finely lirate, long beaked	*Tepidoleda.*

Genus *Scaeoleda.*

1929. *Scaeoleda* Iredale, Rec. Austr. Mus. XVII, p. 158, 14th September.
Orthotype : *Nucula crassa* Hinds.

This genus was introduced for the heavy strongly lirate short beaked southern shells about *N. crassa* Hinds. Associated with them was allowed "*dohrni*" Hanley, a more elongate, more delicate shell with the anterior end smoothened. From Caloundra later was described the species on Hedley's List as "*crassa*", the shell having the shape of *dohrni* but the sculpture of *crassa*, the name selected being *N. caloundra*. Since then Mr. H. S. Mort has found, at Southport, in South Queensland, specimens of the *crassa* series, but these species do not occur in North Queensland.

Scaeoleda novaeguineensis satagea subsp. nov. (Plate I, figs. 7 and 7*a*.)

1885. *Leda novaeguineensis* Smith, Rep. Chall. Zool. XIII, p. 237, pl. xix, fig. 10 : Station 188 (South of New Guinea), 28 fathoms.

This species is sharply angulate posteriorly and elongately oval, completely striate with from thirty to thirty-four teeth ; length 7 mm., height 4 mm., diameter 3 mm. The

Low Isles shell differs slightly in form, more elongate with a little less depth and the mucro more median; the sculpture is a little less defined and the beak not so sharply angled, the teeth are more numerous, more crowded towards the umbones, and are more numerous in the anterior half. The length of a norm is 9·5 mm., with height 4 mm.

The sculpture shows the ribs flattening anteriorly and a little smoothened medially, more raised posteriorly, and thus agrees with that of the typical form, which differs in shape. In the specimen figured, from Low Isles, the posterior teeth number fifteen, long and lanceolate, and the anterior series twenty-three, the length being 10·5 mm. and the height 5·5 mm.

Genus *Eptoleda* nov.

Type: *Leda darwini* Smith.

This group has the umbones median, the beak marked, but not elongated, the depth of the shell more than half its length. The sculpture consists of well-marked concentric ridges over the whole of the shell. The teeth are strong, acute, in series of about equal length, running up under the umbones, above a large broad chondrophore.

Eptoleda darwini Smith, 1884.

1884. *Leda darwini* Smith, Rep. Zool. Coll. 'Alert', p. 111, pl. vii, figs. L, L_2, 12th July: Port Darwin, North Australia.

Many specimens from the 9–12-fathom dredgings at Low Isles show little distinction from the typical figure. Mr. H. Bernhard and Mr. H. S. Mort found many dead valves washed up on the beaches of Keppel Bay, and I secured a number at Seaforth, north of Mackay. These appear to be slightly deeper proportionally than the western type, but the difference is not sufficient for separate diagnosis. Smith's type measured $17\frac{1}{3}$ mm. in length by $9\frac{2}{3}$ mm. in height, and an Eastern shell of the same length may reach 11 mm. in height. The largest valves (from Seaforth) measure 22 mm. in length by 13 mm. in height, and 21 mm. by 13·5 mm.

Lynge has figured (p. 104, pl. i, figs. 18, 19) a shell not unlike this from the Gulf of Siam, which he has called *Nuculana belcheri*, but that name belongs to a South African species, whose figure does not agree at all.

Genus *Zygonoleda* nov.

Type: *Z. corbuloides minutalis* subsp. nov.

This genus comprises species of robust, but very small, form, swollen with acute posterior angulation, strong keeling forms the sculpture and the teeth are comparatively few, and stout.

Zygonoleda corbuloides minutalis subsp. nov. (Plate I, figs. 8 and 8*a*.)

1885. *Leda corbuloides* Smith, Rep. Challenger Zool. XIII, p. 239, pl. xx, figs. 1, 1*a*: Station 188 (South of New Guinea), 28 fathoms.

A common species in the Low Isles, 9–12 fathoms dredgings, was easily recognized as "*corbuloides*", but critical comparison elucidated the following facts: The species was described from a point west of Torres Straits, just inside the Queensland Boundary

Line of 1879, and the figure shows a shell with more than twenty ridges, the earlier ones being wider than the interstices, the succeeding ones narrower. The Low Isles shells have only eighteen ridges, with regularly wider intervals. Torres Straits specimens, which would be nearer the typical form, are larger than any Low Isles shells, and have the beak less pronounced. Shells dredged at North-West Isle, Capricorn Group, in 10–20 fathoms have finer ridges with narrow intervals, twenty-four in number. While these might be regarded as geographic variants only, specimens dredged in Port Curtis, 9–12 fathoms, are definitely deeper and more angulate in shape, with much bolder sculpture, the ridges only numbering fourteen to sixteen.

Lynge (p. 105) records *N. puellata* Hinds as being common in the Gulf of Siam, and Hinds' figure ('Zool. Voy. "Sulphur", pl. 18, fig. 18) recalls this species. An extraordinary feature of Sowerby's figure of *puellata* in Reeve's 'Conch. Icon.' (XVIII, pl. vi, figs. 3, 4) is drawn attention to by Lynge, viz. that that figure shows the sculpture highly irregular and undulating, whereas correctly it should be concentric and regular. Hedley has described ('Proc. Linn. Soc. N.S.W.' XXXIX, 1914, p. 695, pl. lxxviii, figs. 7–9, 26th February, 1915 : Karumba, Gulf of Carpentaria, Queensland) a species, *Leda dasea*, which has sculpture like Sowerby's figure, so that it may be that the figure was drawn from a similar shell mixed with the typical series.

The specimen figured, from Low Isles, measures 5 mm. in length and 3·5 mm. in height ; the hinge teeth are strong and the series subequal in length, the teeth numbering twelve to thirteen on each side.

Genus *Tepidoleda* nov.

Type : T. *lata orion* subsp. nov.

The elongate, thin, broadly-beaked shells are here separated from the stouter, sharply-beaked forms, the degradation of the sculpture being accompanied by the weakening of the teeth ; the latter are sharp and slender, and the anterior series is a little shorter than the posterior, the intervening chondrophore being laterally elongate.

Tepidoleda lata orion subsp. nov. (Plate I, figs. 9 and 9*a*.)

Many specimens were dredged in 9–12 fathoms, Low Isles, whose facies recalled that of *Leda lata* Hinds, which had been added to the Queensland List by Shirley from Bundaberg. Hinds described *Nucula lata* ('Proc. Zool. Soc. (Lond.)', 1843, p. 99, December : New Guinea, 5–23 fathoms, mud), and it was figured in the 'Zool. Voy. "Sulphur"', p. 64, pl. 18, fig. 10, 1845.

Shell of medium size, apparently smooth but faintly lined, thin, inequilateral, not beaked acutely, the anterior side shorter than the posterior, the ventral margin slightly convex medially, ascending rather abruptly at each end, angulate posteriorly, rounded anteriorly. Teeth weak, and rather numerous, sixteen in the anterior series, twenty-three in the posterior series, the specimen figured, from Low Isles, measuring 8 mm. in length and 4 mm. in height.

Before leaving the family Nuculanidae the species on record from Queensland may be discussed :

Leda watsoni Smith ('Rep. "Challenger" Zool.' XIII, p. 238, pl. xix, figs. 11, 11*a*, 1885) from Station 185, off Cape York, in 135 fathoms, looks like a *Scaeoleda*.

L. neaeriformis Smith (*loc. cit.*, p. 240, pl. xx, figs. 2, 2*a*) from same locality, apparently represents a new group, which may be called *Kamaleda*, the hinge teeth being peculiar as stated by Smith.

L. dasea Hedley (' Proc. Linn. Soc. N.S.W.' XXXIX, 1914, p. 695, pl. lxxviii, figs. 7, 8, 9, 26th February, 1915) from Karumba, Gulf of Carpentaria, represents a very distinct group, which is here named *Exocholeda*, the shape, sculpture and hinge teeth being all peculiar.

L. electilis Hedley (*loc. cit.*, p. 695, pl. lxxviii, figs. 10, 11) from Van Dieman's Inlet, Gulf of Carpentaria, may be referred to *Scaeoleda*.

L. narthecia Hedley (*loc. cit.*, p. 696, pl. lxxviii, figs. 12–14) from Horsey River, Gulf of Carpentaria, may be placed under *Tepidoleda*.

Order FILIBRANCHIA.

This Order includes only the Ark-like molluscs, with three families, Limopsidae, Arcidae and Glycymeridae, and thus corresponds exactly with Thiele's group—Stirps Arcacea, which made part of his Order Taxodonta. Apparently Thiele closely followed Cossmann and Peyrot, who divided their Order Taxodonta into two Suborders, Foliobranchiata and Filibranchiata, the latter being Thiele's Arcacea and the Order Filibranchia as here used.

Family Limopsidae.

Although these bivalves have shells so like those of the Globose Arks (Family Glycymeridae) that the species have sometimes been confused, this similarity is regarded as due to convergence, and the true relationship is with the Nuculanids (Family Nuculanidae). They have a long lineage and a wide geographical distribution, and, due to this, there is very little differentiation seen unless the shells be critically examined.

Superficially they can be recognized by their small size, generally compressed, sub-orbicular shape, peculiar sculpture, external triangular ligament pit (chondrophore), and generally smooth interior margins. In life the shell is densely covered with a long silky periostracum.

Two distinct groups can be separated in North Queensland :

Larger, compressed, oblique, chondrophore small, teeth large and few, strongly pectinate . . . . *Oblimopa*.

Smaller, more globose, semi-orbicular, chondrophore smaller, teeth smaller, more numerous and series more curved, weakly pectinate *Circlimopa*.

Although these two groups may be found in the same locality, the former is the coastal representative, while members of the latter group appear in dredgings among the coral reefs.

A large handsome shell, somewhat similar in form, was dredged off the coast of Southern Queensland by Comm. Loring, and was named *Limopsis loringi* by Angas (' Proc. Zool. Soc. (Lond.) ', 1873, p. 183, pl. 20, fig. 6). For this species the genus *Loringella* (Iredale, ' Rec. Austr. Mus.' XVII, p. 160, 4th September, 1929) has been provided. It is easily distinguished by the proximity of the umbones, the lack of shouldering and

the suppression of radial sculpture. This species is also trawled along the northern coast of New South Wales, but there are many other Limopsoid shells found there in dredgings and trawlings, and none of them agrees with the two tropical groups above diagnosed.

Genus *Oblimopa* nov.

Type : *O. macgillivrayi actaviva* nov.

The small Limopsid shells have proved very difficult to determine, and the present genus has been diagnosed above. The shell is comparatively small, the depth being less than one half the length or height, the posterior portion exceeding the anterior, the chondrophore external, equilateral in shape, advancing upon the hinge line, but not suppressing any teeth, which number about thirteen on each side. There is a slight hiatus between the series, the teeth at each end of the series smaller, the intervening ones larger and strongly pectinate. The muscle scars are elongate (oval rather than subcircular), the posterior adductor being larger, and there are suggestions of flangeing present ; above the posterior scar, clearly separated, is a small oval pedal adductor scar. There is also a slight indication of a pallial sinus, and inside the pallial line the interior is radially striate. The internal margins of the valves are quite smooth, and the exterior is clothed with a fine silky periostracum, the underlying sculpture being longitudinal ribs overridden by concentric threads.

Oblimopa macgillivrayi actaviva nov. (Plate I, figs. 11, 11*a*.)

Many varied forms have been allotted to "*Limopsis*", and the large shore form of Queensland has been listed as *Limopsis multistriatus* Forskål. Forskål's work was published posthumously, and was merely a scrap-book of notes such as every young naturalist keeps on his excursions. As most of his finds were novel he provided them with temporary nomination for his own use only, using Arab vernacular for his larger animals, and coining Latin identification tabs for his invertebrates. Forskål was a favourite pupil of Linné, and it is certain that the names published in his name would not be regarded by him as permanent designations. Owing to his unfortunate and untimely death the scrap-book was published as a memorial volume, but the names there given have no technical standing, and must be disregarded. Forskål's regularly constituted names were generally accepted by the early workers, such as Bruguière and Gmelin, so that there is little confusion through the total rejection of the Forskålian names. In the present case *Arca multistriata* was given to a Red Sea shell by Forskål, and was legitimized by Bruguière ('Ency. Meth. Vers.' I, p. 118, 1789), and can be utilized as of that author for the Red Sea form.

A number of specimens was picked up on the beach at Finch's Bay, near Cooktown, and these were all larger, flatter and more oblique than the many dredged at Low Isles. Further they were coloured with shades of brownish, red and purple, while all the Low Isles shells were unicolour, fawn outside and pure white inside. As discussed under the next species, the name *L. macgillivrayi* may apply to this species, but as the description does not exactly apply, and as there has been so much confusion in connection with these tropical Limopsids, the Cooktown shell is here described with a subspecific name. Shell

small, subcircular, oblique, posterior side a little angulately extended; valves convex but somewhat flattened; sculpture of radial ribs overridden by concentric threads. Coloration of figured shell, yellowish white with edges brown; internal coloration similar but much brighter; another shell is purple throughout, the juvenile portion being paler inside and out.

The radial ribs number about forty, but intercalating ribs appear towards the margin where the concentric threads increase in number, but not in strength, and at no time do they produce any nodulose effect.

The figured specimen measures 19 mm. in height and 20 mm. in length or breadth, the depth of the single valve being 4·5 mm. This is much smaller than Red Sea specimens, which measure 27 mm. by 27 mm. by 13 mm.

Prashad has objected to the citation of Bolten in connection with the Museum Boltenianum because Bolten was dead at the time of issue of the work, but has continued the quotation of Forskål as the authority of *Limopsis multistriata* though Forskål was also dead, and I have noted the different points already. Here Prashad concluded, "I have examined all the material of *L. multistriata*, *L. cancellata*, *L. woodwardi* and *L. philippi* (*sic*) in the collections of the British Museum (Nat. Hist.), London, and agree with Cooke and Smith that they all represent different stages in growth of the same species. The small differences in form of the shell, as was pointed out by Smith, are of no importance for the distinction of the species, and the shells of the above-noted species do not show any other differences either in the sculpture or in the hinge. *L. multistriata* is widely distributed in the Red Sea and the Indo-Pacific".

It will be noted that Prashad has overlooked *L. macgillivrayi*, described by A. Adams at the same time as *L. philippii* and *L. woodwardi*, though it was noted as "most nearly resembling *L. multistriata*".

Genus *Circlimopa* nov.

Type: *C. woodwardi mutanda* nov.

This genus includes smaller species, more circular in shape, more globose in form, the chondrophore definitely smaller, scarcely intruding upon the hinge, which consists of two series of teeth, meeting under the chondrophore but not touching, the teeth smaller, twelve to fifteen on each side and weakly pectinate with not much discrepancy in size. The shell is more thickly clothed in life and the concentric threads are weaker, not overriding the radials.

The muscle scars are comparatively larger, the flanging a little more distinct, hence the scars, especially the posterior one, more square and less oval; the inner marginal ledge is much more pronounced.

The differences between the two groups here indicated are very striking when ample material is available, and consequently the conclusions of Cooke and Smith, although accepted by Prashad, are definitely incorrect, the "*multistriata*" series always contrasting notably with the "*cancellata*" one.

Circlimopa woodwardi mutanda subsp. nov. (Plate I, figs. 12, 12*a*, 12*b*.)

Numerous valves and many specimens of a small Limopsid occurred in the dredgings from 9–12 fathom sat Low Isles. In the 'Proc. Zool. Soc. (Lond.)', 1862 (publ. 10th April,

1863), A. Adams described three species of *Limopsis*, *viz. L. philippii*, p. 230, *L. macgillivrayi*, p. 230 ; and *L. woodwardi*, p. 231. The first named was assigned no definite locality, but the last two were credited to " Lizard Island, Torres Strait ". The first named was said to be "gibbous . . . oblique ", the second was "oblique ", and the third "nodulous ". Apparently none has been figured, but Smith (Rep. Zool. "Challenger"' XIII, p. 256, 1885) included *woodwardi* and *philippii* as synonymous with *Pectunculus cancellatus* Reeve (' Conch. Icon.' I, pl. vii, sp. 39, June, 1843) described from Singapore, 7–10 fathoms.

Lynge (p. 129) recorded *Limopsis cancellata* Reeve, from the Gulf of Siam, and accepted Smith's synonymy. Reeve's specific name, however, was invalid, being preoccupied by Michelotti (' Ann. Sci. Lomb. Ven.' IX, p. 13, 1839, *fide* C. D. S.), so Sacco (' I. Moll. terr. terz. Piem. e Lig.', pt. xxvi, p. 42, footnote, December, 1898) provided a substitute *Limopsis excancellata*, which name does not appear in the ' Zoological Record '.

In the meanwhile Martens (' Sitzb. Nat. Freunde Berlin ', 1881, p. 66) also described a *Limopsis cancellata* from off Moreton Bay, but that usage was also anticipated by Tenison Woods (' Papers Proc. Roy. Soc. Tasm.', 1876, p. 156, 1877) for a Bass Strait shell. Smith reported that the sculpture of the three species he synonymized was essentially the same and the hinge teeth about twenty-two in number, and the ligamental pit was quite similar in all, disregarding the difference in form as being of little importance.

Series seem to disprove the above conclusions as the variation is seen to be localized, and the individual differences easily determinable. The Low Isles shells are small, orbicular and equilateral ; no large ones were met with ; a few were a little less orbicular than others but none could be termed oblique : certainly none were oblique and gibbous, and the word " nodulous " could scarcely be used in describing any. Firstly, we can dismiss *L. philippii* as no locality was given, and being " more gibbous than any other species " it differed from the Australian species *macgillivrayi* and *woodwardi*. Then *L. macgillivrayi* from Lizard Islands was " most nearly resembling *L. multistriata* ", so that it would be available for our shell so-called were it from the mainland. It is stated to be " albida ",whereas the mainland shells are mostly coloured, but as Lizard Island is a mainland island, though comparatively distant from the coast, it may be a form of this species. This leaves *L. woodwardi*, also from Lizard Islands, and that species was described as "orbiculari . . . convexa" "pure white . . . very delicately sculptured . . . hinge teeth sharp and prominent . . . concentric lirae cause the radiating ribs to assume a nodulous character ".

In order to get some degree of accuracy it is here proposed to allot *macgillivrayi* to the *Oblimopa* series and allow *woodwardi* in the *Circlimopa* group, and name the forms as subspecies. The Low Isles form is here named *C. woodwardi mutanda*, and is thus described : Shell small, orbicular, plumply convex, as broad as long, but with age longer than broad, and also decreasing in width so that it is broadest near the hinge. Coloration dirty white to fawn, a thin long silky periostracum covering the shell in life. Sculpture of radials numbering from forty to sixty, minor ones intercalating with shell growth ; concentric lirae crossing the radials but only forming subnodules. The umbones are smooth and in the juvenile stage the hinge is curved, the series meeting evenly but with growth the series become disjointed, the posterior series overlapping the anterior below the umbones. In some juveniles the flange at the edge of the posterior adductor is pronounced, but it becomes obsolete with age.

The figured specimen, from Low Isles, measures 9 mm. in height, and breadth or length ; the conjoined valves are 6 mm. in depth.

Shells dredged at Albany Passage, Torres Straits, 9–10 fathoms, by Mr. Melbourne Ward, are larger, flatter, more compressed, comparatively more oblique, more densely clothed than the Low Isles series ; the sculpture is scarcely nodulous at all ; the teeth are more numerous and more closely packed, and the shells are larger, the specimen figured being 13 mm. in height, 12·25 mm. in length or breadth, and 7 mm. in depth. This may be called *Circlimopa woodwardi mella* subsp. nov. (Plate I, figs. 13, 13*a*).

Another series secured at North West Islet, Capricorn Group, by Messrs. Melbourne Ward, G. P. Whitley and myself provides another form, which is still larger, not oblique, flattened and broader than high, practically equilateral. The sculpture is stronger, the main ribs fewer and the intercalating ones finer, the concentric threading being also coarser, and the threads more separate. Curiously enough, although the shell is broader, the hinge is smaller, the teeth being small and more crowded. This subspecies may be named *Circlimopa woodwardi piabilis* subsp. nov. (Plate I, figs. 14, 14*a*, 14*b*), the figured specimen measuring 13·5 mm. in height, 15 mm. in breadth, and 6 mm. in depth.

Specimens from Singapore, sent by Mr. J. le B. Tomlin to this Museum, are small, and rather unlike any of our forms, but Reeve's *cancellatus* from Singapore was larger, and more oblique, and apparently very distinct.

Before leaving this group *Limopsis torresi* Smith (' Rep. Zool. " Challenger " ' XIII, p. 255, pl. xviii, figs. 4, 4*a*, 1885, ; Station 185B, Raine Island, Torres Straits, 155 fathoms) must be mentioned. It is a small convex shell, 3⅓ mm. long, 3½ mm. high, with a diameter of 2¼ mm. : rather oblique. Thus it might be considered as the juvenile of *C. w. mella* above, but from its habitat it would not be, and this is determined by the description, " The interior . . . has the outer margin, especially the lower part, denticulate within ". This removes it altogether from this group as the internal margins of *Oblimopa* and *Circlimopa* at all stages are very smooth.

Family Arcidae.

The members of this family are very difficult to differentiate without careful study, and as they prove and show very clearly the distinction between the mainland forms and those of the coral reef, they have been very carefully examined.

Lamy has published a review of the Arks, based upon the specimens in the Paris Museum, and, while this is very helpful as regards literary records, it is not completely acceptable as to conclusions concerning relationships and specific variation. Species have been lumped and a world-wide range suggested when as a matter of fact many species and subspecies exist, while on the other hand species have been allowed whose existence is purely literary. The series collected in the field separate themselves, though single specimens in museum collections might appear inseparable. At the present time the most meticulous discrimination is absolutely necessary, but this does not mean " splitting ", it only means recognition of natural facts as displayed through large collections.

Through intensive collecting on the mainland and on the coral reefs of Queensland two absolutely distinct series of species can be distinguished. This is probably the most unexpected result in view of the wide range previously accepted in this family, and the long synonymy that has been collated in this connection becomes quite valueless.

The recognition of the essential distinction of the formation of the ligamental covering has suggested a still further advance in our systematic treatment, and probably even a number of families will be separated from the family as now understood in the near future. This is not attempted here as still more study is necessary, but the species have been criticized carefully so that later work will be easier. It will be shown that owing to ignorance of the value of the development of the ligamental covering, species, having no close relationship, have been carelessly classed as pure synonyms. Critical examination of small details has thus been justified, and shows that the initiative in taxonomic work on this large and important group must now be transferred from the palaeontologist to the neontologist. Consequently while hitherto nearly all the good work performed in connection with Arks lies to the credit of palaeontologists, all the best work of the future must be done by the neontologist, and it is hoped that this account will indicate the method of approach, and will be only the forerunner of many critical essays. To cover all the species commonly referred to " Arca " a comprehensive diagnosis might be drawn up reading somewhat as follows :

Shell ranging in size from 2 mm. to 200 mm., oblong, oval, or subcircular, generally longer than high, shell thick or thin, valves usually inequilateral, sometimes inequivalve, swollen or compressed, ventral edge almost straight, rounded, or sinuate and posteriorly expanded, inner edge smooth, striated or plicate, interior also sometimes notably striate or even lirate ; muscle scars, two, sometimes three, and often with additional smaller scars showing, rarely bounded by a flange; shape of scars variable, round, oblong or elongate; hinge line curved or straight; hinge teeth many, varying from twenty to one hundred in number; teeth horizontal, vertical, sloping or straight, serrated or plain, with a hiatus separating the two series, which are commonly of unequal length and number of teeth ; at times the series overlap, and at others are continuous. A large ligamental area is usually present sloping inwards and showing a ligamental covering of varying extent and of diverse formation. External sculpture mostly of radial ridges, few or numerous, regular or irregular, nodulose or even cancellate ; a median depression more or less persistent from the umbones marginad. Periostracum of many kinds, from dense horny plates to fine silky covering becoming obsolete.

As such a " diagnosis " is useless for the purpose of determining the relationships and affinities of species many smaller groupings must be utilized, and usually these have been called subgenera, and then as even these subdivisions became unwieldy and inaccurate a further separation into sections was made. Latterly it has become a custom to pretend that such valuation was being used but the names were written as carrying a higher status; thus the so-called subgeneric names were written as if they were genera but such sophistry is not here accepted. In this place all the small groups are diagnosed succinctly and are named as genera and the names so used. There is the possibility of further knowledge enabling the association of these small groups into fewer larger ones, but at present it cannot be done with the exactitude demanded of present-day systematists. Of primary importance is the nature of the covering of the ligament, and especially its mode of growth, as two diverse and distinct methods can be seen, each of which culminates in a similar fashion, *i. e.* in the entire covering of the ligamental area. Of secondary importance is the apparent hinge, as this has also developed in various ways ; sometimes the teeth become fewer with age, sometimes they become more numerous. Here again the hinge must be studied in all stages from juvenile to adult.

An overlooked angle of study appears to be that concerned with the adductor muscle scars, and these must be taken into consideration hereafter in determining relationships of odd species. Thus the posterior adductor scar is always larger than the anterior, but the proportions vary quite appreciably. In shape the posterior scar may vary from almost circular to elongate and rather squarely angulate. In *Navicula* the posterior is not much larger than the anterior, both being circular in shape, while there is a large elongate pedal adductor scar along the hinge, which beginning near the end of the posterior adductor, extends almost half as long again as the diameter of the posterior scar.

In *Arca* (=*Barbatia* olim) the anterior and posterior scars are again both subcircular but the posterior scar is twice the size of the anterior ; the pedal adductor scar is long, thin, elongate, extending along the hinge in front of the posterior adductor. Similar scars appear in *Savignyarca*, the position of the pedal adductor scar is a little more anterior while the anterior scar is less circular. In *Opularca* the scars are still subcircular but the anterior scar is not much less than the posterior, while the pedal adductor is reduced in length. *Ustularca* shows a large suboval posterior scar with a small irregularly subcircular anterior, the pedal adductor is elongately oval, situated above the posterior adductor, in front of which are three little pits.

In *Anadara* the posterior scar is elongately square showing advancement with growth and the anterior scar is similar but much smaller : the pedal scar has almost vanished, only a small spot being sometimes seen. In *Trisidos* similar scars are seen, being more elongated and showing advancement more clearly in *yongei* than in *semitorta*, but more impressed in the latter, and the scars are more distant from the hinge line than usual. In *Scapharca* the posterior scar is less elongately square, produced medially, with little advancement seen, while the anterior scar is short and higher than broad, but not much less than the posterior; the pedal scar is only seen easily in dead shells as a lengthened one directly above the posterior.

When the small shells are examined the muscle scars can be seen to agree with the superficial features, so that we find in *Acar* a series resembling those of *Arca* (=*Barbatia*) on a small scale, but comparatively larger and with the pedal scar in front of the posterior one not directly above it, both posterior and anterior being subcircular and subequal. Referring to *Gabinarca* and *Mulinarca* the muscle scars are entirely different, being elongated smaller forms of the style of *Anadara*, *Scapharca* and *Trisidos*, the third scar being notably large in comparison.

Before making any conclusion about the alliance of any obscure species (most species fall into place very easily) the muscle scars should be studied.

The Arks are here arranged under many generic names, as there can be no other conclusion save that many phyletic groups are represented and that superficial likeness is not a sure guide to affinity.

Large, oblique, swollen, side teeth of hinge parallel to it, ligament median . . . . *Cucullaea.*

Large, elongate, compressed, hirsute, ligamental area narrow covered, the ligament beginning posteriorly; hinge line short, exterior teeth large and sloping . . . . *Arca.*

Medium, very oblique, attenuated anteriorly, ligament strong, external teeth fewer and larger . . . . *Savignyarca.*

Small, rather solid, a little narrowed anteriorly, ligament very strong, hinge teeth few and large, and appreciably slanting . . . *Barbatirus.*
Small, solid, strongly keeled posteriorly with strong reticulate sculpture, ligament not covered, covering posteriorly only, teeth few . . *Acar.*
Small, solid, strongly keeled posteriorly with ribs strongly beaded, vitreous in appearance . . . . *Vitracar.*
Small to medium, not solid, no posterior keeling, and sculpture of radial ribs typically composite, ligament covering posteriorly only, hinge teeth small and many . . . . *Mabellarca.*
Very small, elongate, inequivalve, flattened ribs, hinge line long, teeth small and numerous, ligamental covering small, posterior . . *Miratacar.*
Very small, elongate, equivalve, finely ribbed, hinge line long, teeth comparatively large, posterior small covering on ligamental area . *Mimarcaria.*
Very small, subglobose, thin, deeper than broad, hinge line, teeth delicate, ligament on posterior portion of area only . . . *Thronacar.*
Large, dark brown inside and out, suboval, hinge line curved, curve dislocated medially, sculpture many finely nodulose ribs . . *Ustularca.*
Medium, white, very thin, swollen, oblique, sculpture very fine radials, ligamental area narrow, hinge teeth small and few in number . *Opularca.*
Large, of thin texture, twisted, hinge line oblique, teeth at extremities larger, sometimes obsolete medial, generally keeled posteriorly, ligament weak or strong, area narrow . . . . . . *Trisidos.*
Large, swollen, solid, ligamental area broad or narrow, covered with a chevron-marked ligament, beginning posteriorly, hinge line straight, teeth many, vertical, rarely sloping, equivalve in adult but inequivalve in juvenile, sculpture of radial ribbing only . . . *Anadara.*
Shell large, stout, inequivalve, sculpture on valves discrepant, ligamental covering and hinge as in *Anadara* . . . . . *Imparilarca.*
Shell large, thin, subglobose, swollen, valve sculpture scarcely discrepant, inequivalve, other details as in *Anadara* . . . . *Scapharca.*
Small, solid, very swollen, almost globose, valve sculpture discrepant, inequivalve, ligamental covering without chevron markings . . *Potiarca.*
Large, solid, swollen, elongate, sculpture of few granose ribs, inequivalve, ligament and hinge as in *Anadara* . . . . . . *Tegillarca.*
Very small, stout, obese, sculpture reticulate, ligamental area having a small medial diamond ligament . . . . *Gabinarca.*
Very small, thin, translucent, sculpture of prickly ribs, ligamental covering as in *Gabinarca* . . . . *Spinearca.*
Very small, thin, opaque, elongate, sculpture of fine subnodulose ribs, ligamental covering as in *Gabinarca* . . . . *Mulinarca.*
Medium, thin, equilateral, elongate, sculpture of very fine ribbing, ligamental area covered, with vertical lining of the ligament, beginning from the middle of the area . . . . . . *Estellacar.*
Very small, thin, compressed, sculpture of fine plain radials, ligamental area narrow with a broad medial diamond covering, hinge line curved, teeth small and many . . . . *Verilarca.*

Very small, thin, a little swollen, umbones very anterior, ligamental area very narrow and covered in the manner of *Arca*, not of *Gabinarca*, hinge line curved . . . . *Didimacar*.

Large, elongate, thin, oblique, sculpture of radials, ligamental area very narrow, the ligamental covering being of vertical ridges . *Barbatiella*.

Large, elongate, solid, sculpture of radials, cancellate, byssal aperture large, ligamental area very broad, ligamental covering beginning as a medial diamond and sometimes covering the whole of the area, hinge line straight, teeth very numerous . . . . . *Navicula*.

Large, elongate, thin, sculpture of rather distant divided radials, ligamental area covered, hinge line straight, teeth very numerous, coloration white, periostracum thick . . . . . . *Mesocibota*.

Genus *Arca*.

1758. *Arca* Linné, Syst. Nat., 10th ed., p. 693, 1st January.

Before any species can be ascribed to *Arca* in a restricted sense its correct usage must be determined. This is not easy, as three or four complications ensue. Of course Linné selected no type, and there is no indication from the species included which should be so regarded ; consequently the worker who first named as type one of the species must be followed and this is where trouble begins. Until quite recently all oblong multidentate shells were classed in *Arca*, irrespective of their inter-relationship. No detailed work upon recent species has been attempted, but palaeontologists have placed on record much data with much discussion, and their conclusions must be reviewed in relation to recent species, especially as there are so many tropical Pacific forms. Thus, in the material from Queensland under notice, about fifty species of "*Arca*" are represented, a faunula unsurpassed in any recent account. Half-a-dozen notable groups stand out, and as many more less distinctive but probably just as important have to be considered.

However, the most necessary step is the distinction of *Arca*, and the rigid construction of the rule of type designation dismisses the claims of Lamarck, Schumacher, Schmidt, Children, etc., but apparently allows Anton as anterior to the commonly accepted Gray. To consolidate the matter, it may be noted that Lamarck used *Arca* with a single species in 1799, and in this case in 1801 the same species was named, but in 1818 the species *tortuosa* was placed at the head of the list. Through this action Children (then anonymous) cited *tortuosa* as type of Lamarck's genus *Arca*, which it obviously was not. Misled by secondhand information, some writers have declared *tortuosa* to be the type of Linné's *Arca*, as fixed by Children, which is quite inaccurate. It has also been suggested that Schumacher designated *antiquata* as type, but that species was named " pour le type ", *i. e.*, as an example for illustration only, exactly as Children had done with the species of Lamarck. Unfortunately Anton cannot be ruled out as he definitely indicated as types in the strictest sense, and for *Arca* his selection was *barbata*. It has been declared that *noae* has right by traditional usage, but this statement is not borne out by the fact that Blainville in 1825 had introduced for the *noae* series a genus *Navicula*, and independently Swainson had decided *noae* was not a " typical Ark ", and had proposed *Byssoarca* for it and its associates.

Nine years after Anton's determination Gray named *noae* as type, and proposed

Barbatia for the *barbata* series. This usage has been most commonly followed, but practically speaking only the name *Arca* has been used for a very incongruous association. Undoubtedly the family must be divided into genera and subgenera, and probably in the near future very many will be recognized, and the name *Arca* restricted to a very small series.

Arca will therefore be used in this report for the species similar to *barbata*, while *Navicula* will come into service for the *noae* group. These two groups differ in every detail, and the former seems closely related to *Trisidos* and *Cucullaea*, yet both these genera are represented in palaeontology, the latter especially so. As a matter of fact, all the recent groups of Arcidae are well developed and separated, two forms of ligamental covering being essentially distinct. Thus what may be called the "*Acar*" style differs absolutely from what may be called the "*Fossularca*" form. In the former the cardinal area is swollen anteriorly, and the ligament begins behind the umbones and extends until the whole area may be covered. In the latter the ligament appears directly under the umbones as a small diamond and develops on each side until the area is covered. Stoliczka ('Pal. Indica' III, p. 332, 1871) observed that "*Arca* and *Barbatia* are already found represented in the Silurian rocks"; he also gave animal characters of three species, which he differentiated generically, viz. "*Anomalocardia rhombea* Born from the Arracan coast with no byssus, *Barbatia helblingii* Bruguière from the Nicobars, and *Scapharca gubernaculum* Reeve, dredged in 2–4 fathoms near Penang, with a byssus". Stoliczka's *Arca* has the "*Fossularca*" ligament, his *Barbatia* has the "*Acar*" ligament, but his *Anomalocardia* and *Scapharca* have been recently lumped together under *Anadara*.

Genus *Cucullaea*.

1801. *Cucullaea* Lamarck, Syst. Anim. s. Vert. p. 116. 1st January.
Haplotype: *C. auriculifera* Lam. = *Arca labiata* Solander.
1815. *Cuculina* Rafinesque, Analyse Nat. p. 147: new name for *Cucullaea* Lam. *Cf.* Iredale, Proc. Mal. Soc. (Lond.) IX, p. 262, 1911.

The extraordinary Ark-like shells included under this genus range along the whole Queensland coast and into New South Wales waters. Family value has been given this genus mainly on account of the hinge teeth, the flanged muscle scar and the antiquity of the group. Yet the hinge can be paralleled among the true Arks, the muscle scar is not flanged in the juvenile while there are some small Arks which show a scar flangeing, and many Ark groups are also well distinguished in early palaeontological ages. It may be admitted that on the first finding of very small shells of this group they were regarded as Arks, and only when growth series were sorted out was their identity recognized.

Cucullaea labiata petita subsp. nov. (Plate II, figs. 1, 1*a*; Plate II, figs. 17, 17*a*, 17*b*.)

1786. *Arca labiata* Solander, Cat. Portl. Mus. p. 185, 8th April: based on D'Avila, I, pl. xviii: "Indes".
1789. *Arca concamera* Bruguière, Ency. Method., Vers, I, p. 102; 1st reference to Davila, others to Martini, Favanne and Martini, figs. 526–528: Mer des Indes.
1791. *Arca cucullus* Gmelin, Syst. Nat. pt. vi, p. 3311, based on Chemn. 7, t. 53, figs. 526–528: Nicobar Isles and Tranquebar.
1798. *Arca cucullata* Bolten. Mus. Bolten, pt. II, p. 173, September; emendation of Gmelin's name only.
1801. *Cucullaea auriculifera* Lamarck, Syst. Anim. s. Vert. p. 116; new name for "*Arca cucullata* Chemn.".

This synonymy is here displayed to eliminate certain erroneous conclusions as to the nomination of the species. Thus *Cucullaea granulosa* Jonas ('Proc. Zool. Soc.

(Lond.),' May, 1846, p. 36) was proposed for a specimen from the Chinese Seas, which showed prominent granulose sculpture, and may be retained in that connection. Sowerby admitted ('Conch. Icon. (Reeve)', XVII, August, 1869) three species, *C. concamerata* and *C. auriculifera* from the Isle of France, and *C. granulosa* from Chinese Waters. Sowerby's figures of his *concamerata* and *auriculifera* look rather different, but it seems improbable that there should be two species at the Isle of France, and as shown above the two names used by Sowerby are absolute synonyms. Then Dunker ('Index Moll. Mar. Japon', p. 235, 1882), regarded the Japanese species as *concamerata*, admitted *auriculifera* as different, and suggested there might even be a third species (*granulosa* Jonas).

The earliest binominal name is that given by Solander as above, and that depends on D'Avila's figure, which was localized as from the "Indes". Then Bruguière used the name *Arca concamera*, citing D'Avila's, Martini's, Favanne's and Martini's figs. 526–528 in connection. At the first reference to Martini the name *Arca concamerata* was used, but at that time Martini was not binominal. The second reference to Martini is to the 'Syst. Conch. Cab.' begun by Martini and continued by Chemnitz, so that sometimes the one name and sometimes the other is cited with the figs. 526–528. Chemnitz (VII, p. 174, pl. 53, figs. 526–528, 1789) used the non-binominal name "*Arca cucullata et concamerata*" (p. 165), and the two larger figures (526, 527) represent shells from the Nicobar Isles, while the small one (528) was from Tranquebar. Gmelin based his name *Arca cucullus* on Chemnitz's account, and Bolten's *Arca cucullata* was simply a correction of the name.

When Lamarck introduced the genus *Cucullaea* he, to avoid tautonymy, coined a new specific name, *auriculifera*, and this combination was used for some years. Deshayes ('Hist. Anim. s. Vert.' (Lamarck), 2nd edition, VI, p. 454, note, 1835) revived Martini's name *concamerata*, and this alteration was commonly accepted. It is of historical interest only to note that Theobald, Jun. ('Cat. Rec. Shells Mus. As. Soc. Bengal', p. 126, 1860) gave the name *Cucullaea plicata* to the Indian Ocean shell without description. In the late continuation of Martini and Chemnitz's 'Syst. Conch. Cab.', Kobelt (Bd. VIII, heft x, p. 61, 888; heft xxv, p. 228, 1891) regarded Chemnitz's figure 528 as representing *granulosa* Jonas, for which he cited no publication. Lamy in his "Revision des Arca vivants" ('Journ. de Conch.' LV, pp. 306–7, 1907) allowed two species, *Cucullaea concamerata* from the Red Sea (subfossil) and the Indian Ocean, and *C. granulosa* from the Red Sea (living), Singapore, China and New Caledonia.

Obviously, from the preceding, the Indian Ocean shell must bear the name *labiata*, of which *concamera*, *cucullus*, *cucullata*, *auriculifera*, *concamerata* and *plicata* are absolute synonyms. The species from the Chinese–Japanese Seas must be called *granulosa*, and other forms determined from these bases. Apparently the Red Sea form should be distinguished as the subfossil and living forms were allotted to two different species.

I have already separated the New South Wales species as *Cucullaea vaga* ('Rec. Austr. Mus.', XVII, p. 385, 1930: off Norah Head, N.S.W.), and the North Queensland shell is quite distinct, but its relationship to the Indian Ocean shell is not too definite without material. From descriptions and illustrations the extra-limital species is more granulose than the local one, a specimen from Northern New Guinea being easily separable, and coming nearer the Chinese *granulosa*.

The North Queensland shell ranges down as far as Keppel Bay whence Mr. H. Bernhard has sent me specimens along with the southern *vaga*, which alone is found further south, the limit at present being Shoalhaven Bight. Southern fossils belong to a different section

of *Cucullaea*. Only a fragment was secured in the 9–12 fathoms dredging off Low Isles, but a beautiful little specimen was dredged by Mr. Melbourne Ward in the same depth in Albany Passage, North Queensland, and this is here used as type of the new subspecies *Cucullaea labiata petita* (pl. ii, figs. 1, 1*a*). This form differs from *vaga* in shape, being more elongate, with the posterior area more finely sculptured, some forty-five ribs being counted against twenty-five in the former. The ribs are generally more numerous, and the concentric lining is also closer, forming faint squarish nodulation, but not a notable granulose sculpture. This sculpture and form continues in the largest sized shells, as seen from Keppel Bay. Also in the Low Isles dredging some small rather globose shells were found which recalled the Australian shells previously recorded as *Bathyarca*, but unlike those they showed no flange below the posterior muscle scar. The hinge vaguely recalled *Cucullaea* and they were regarded as representing a new form of Ark, but a series dredged off Lindeman Island by Mr. Melbourne Ward and myself showed that they were really the juvenile of this species. These are figured on Plate II, figs. 17 *a*, *b*, and may be described as follows :

Shell very small, inequivalve, inequilateral, tumid, more swollen posteriorly, dorsal margin straight, ventral margin very sinuate, anterior side truncate, posterior side almost twice as long, similarly truncate. The umbones are well incurved showing a marked median depression, the posterior area swollen descending deeply but not carinate. Ligamental area narrow, no covering. Sculpture of distant ridges, minor riblets intervening, the intervals latticed. The hinge line straight, two or three sloping, almost horizontal teeth at each side, becoming smaller and less sloping towards centre, where they are vertical ; scar-flanges scarcely noticeable. The figured specimen measures 6 mm. in length, 5 mm. in height and 4 mm. in depth. The larger specimens are still similar in shape but the sculpture is becoming modified and the shape a little more regular, less swollen posteriorly : still larger, 15 mm. in length, the ligamental area shows a median lengthened covering, not reaching either end.

Prashad (p. 57) has admitted *Cucullaea granulosa* Jonas as a distinct species, but unfortunately he did not consider geographical distribution, and thus while the specimens from Macassar should be most like the Chino-Japanese form, *granulosa*, he apparently confirms Lamy's range of Red Sea, Gulf of Aden, Singapore, China and New Caledonia. Specimens from Ceylon which are obviously typical *labiata* differ in their finer sculpture from the Queensland ones and do not agree in shape, being comparatively rounder, less oblique and apparently more swollen. The ribs are broader, fewer, with more marked interstices, and the concentric sculpture is weaker and more crowded.

Genus *Arca*.

1758. *Arca* Linné, Syst. Nat. 10th ed., p. 693, 1st January.
Logotype : Anton Verz. Conch. 1839, p. 12 = October, 1838, *Arca barbata* Linné.

1840. *Barbatia* Gray, Synops. Contents Brit. Mus. 42nd ed., pp. 151–155, *nom. nud.* ; 44th ed., p. 76, 1842 ; Proc. Zool. Soc. (Lond.), p. 197, November, 1847.
Orthotype : *Arca barbata* Linné.

1857. *Thyas* H. and A. Adams, Gen. Rec. Moll. II, add. p. 660, November, *ex* Gray MS., as synonym of *Arca*.
Not *Thyas* Koch, Deutsch. Crust., Ins. (5), pl. xviii, 1837.

Shell as here understood, elongate, a little oblique, rather fine radially sculptured, comparatively dense horny periostracum, large byssus and narrow byssal gape.

Ligamental area long and narrow covered with a ligament showing chevron markings but beginning behind the umbones and advancing beyond them. That is, the juvenile is opisthodetic, and the adult apparently amphidetic, furnishing a pseudo-amphidetism. The teeth are moderately numerous, but through the intrusion of the ligamental area the median ones become obliterated and the external fewer and larger slanting teeth only remain. The muscle scars are subcircular, the posterior twice the size of the anterior.

In connection with *Arca* as here distinguished the names *Obliquarca*, *Savignyarca* and *Barbatiella* call for comment, *Barbatia* being regarded as an absolute synonym of *Arca*. The first named must be restricted to fossils, as the latter two are easily separable among recent shells though the former has been used for all three.

Arca corallicola sp. nov. (Plate II, figs. 2, 2*a*.)

Some half-a-dozen names had apparently been used for the same Ark in Queensland waters, through attempts to utilize extralimital names, and in endeavouring to straighten out the matter a large quantity of material was necessary. Hedley included in his Queensland List *Arca foliata* Forskål, and *A. decussata* Sowerby, while Shirley added *A. nivea* Gmelin from Moreton Bay, *A. helblingii* Chemnitz from Yeppoon, and *A. lima* Reeve from Gladstone. While it is possible to allow Hedley's two species, one as the mainland form, the other as the coral reef species, the localities cited by Shirley all refer to the mainland species. Though the shells are superficially similar, the mainland shell has the posterior end broadly ribbed while the reef shell is more sharply sculptured by growth lines, and the radial ribs do not broaden on the posterior area. Both species are apparently commonly malformed, the byssal cavity long and narrow, the anterior end generally narrowed, the posterior end very much broadened. *Arca sinuata* was given to a shell by Lamarck ('Hist. Anim. s. Vert.' VI (i), p. 38, July, 1819) from New Holland, but Lamy ('Journ. de Conch.' LII, p. 141, pl. v, fig. 10, 17th September, 1904) has figured the type, a very deformed shell, indeterminate. It is probable that Shirley's addition of *A. lima* Reeve was due to a determination by Smith, as the latter had recorded shells from Port Molle and Thursday Island as Reeve's species in the "Alert" Report. Reeve's species ('Conch. Icon.' II, pl. xv, sp. 101, May, 1844) was described from the islands Burias and Corregidor in the Philippine Islands, and has recently been allowed by Lynge (p. 113) from the Gulf of Siam, who wrote: "The following species may safely be reckoned as synonymous: *B. oblonga* Dunker, *A. granulata* Philippi, and *B. aceraea* Melvill and Standen", also noting that Smith ('Proc. Zool. Soc. (Lond.)', p. 431, 1891) had suggested that *trapezina* "Lam." Reeve might be only a form of the same species. It is very *unsafe* to suggest synonyms from reference to figures as *B. aceraea* Melvill and Standen proves to belong to a different genus or group.

Lamy has figured *Arca trapezina* Lamarck ('Journ. de Conch.' LII, p. 142, pl. v, figs. 4, 5, 17th September, 1904) from Lamarck's specimen which was localized ('Hist. Anim. s. Vert.' VI (i), p. 41, July, 1819) as from "Timor and King Island". The figure is of a shell of the "*decussata* Sow." series, but the remainder of the shells under the name, grouped by Lamarck, are of the "*helblingi*" form. The King Island locality is erroneous, so that Timor may be accepted, and the name will not concern us at present. It may be considered later in conjunction with specimens from West Australia.

From a multitude of names Lamy selected *nivea* Chemnitz as the specific name of

an Ark, to which he gave almost world-wide range. As synonyms he recorded *scaphaciuncula* Meuschen, *candida* Chemn., *complanata* Chemn., *ovata* Gmelin, *candida* Gmelin, *jamaicensis* Gmelin, *helblingii* Brug., *sinuata* Lamarck, *sulcata* Lam., *trapezina* Lam., *paulucciana* Tapp.-Canefri and *nova* Mabille, adding *velata* Sowerby with varietal rank. The recognition of three distinct species in Queensland waters, which have at times been called by some of these names, necessitates revision with due regard to geographical distribution. It may be noted that for this same complex Lynge used *complanata* Chemnitz, while Hedley has preferred *foliata* Forskål. As neither Chemnitz nor Forskål can be recognized as binominal authorities it is imperative to investigate every name. With regard to priority it is found that Forskål's name *foliata* was published in 1775, the locality being the Red Sea. To Forskål's name, Chemnitz, in 1784, added a full description and used a polynominal name, *nivea* being the first predominating adjective. However, in 1791, Gmelin, systematizing in a legitimate manner the Chemnitzian species, did not select this term but introduced *ovata* instead, and thus *ovata* Gmelin becomes the first legal name for a Red Sea Ark of this facies ; just for record, it may be observed that Bolten in 1798 did legitimatize the name *nivea*, but then it was too late. In 1779 Helbling described a similar Ark from " Guinea and the West Indies " as *Arca candida*, and apparently in a binominal mode. This was polynominally named by Chemnitz in 1784 as *Arca candida helblingii* . . . and Bruguière in 1789 made the binominal name *Arca helblingii*, and Gmelin in 1791 accepted *Arca candida* as the binominal contraction. These names refer to an Atlantic Ocean species, and thus do not concern us further.

Another name was introduced by Meuschen in 1781 when he gave *Arca scaphaciuncula* to a shell figured by Gronow from Ceylon. At the same time Meuschen proposed the name *Arca scapha* for a very different shell, but in 1791 Gmelin used the name *scapha* for Meuschen's *scaphaciuncula*, and since then there has been confusion between these two " *Arca scapha* ". The fourth name that appears in the early literature is that of *complanata* of Chemnitz in 1784, who described a shell from Madagascar, with a polynominal phrase, *complanata* being the first adjective ; this was used as a binominal by Bruguière in 1789 and is only available from that date.

In order to disentangle this perplexing series of names a chronological and geographical list is appended :

Arca foliata Forskål, 1775, non-binominal. Red Sea.
nivea Chemnitz, 1784, non-binominal.
ovata Gmelin, 1791, binominal.
nivea Bolten, 1798, binominal.
All these names are based on the same foundation.

Arca candida Helbling, 1779, binominal. Guinea and West Indies.
c. helblingii Chemnitz, 1784, non-binominal.
helblingii Bruguière, 1789, binominal.
candida Gmelin, 1791, binominal.
All these names are synonymous exactly.

Arca scaphaciuncula Meuschen, 1781, binominal. Ceylon.
scapha Gmelin, 1791, based on same species.

Arca complanata Chemnitz, 1784, non-binominal. Madagascar.
Bruguière, 1789, binominal.

After Chemnitz, whose beautiful work was non-binominal, but whose species were

legally nominated by later workers, as Bruguière, Gmelin and Bolten, came Lamarck, and Lamarck described very many Australian shells. Two have been discussed above and neither is here utilized. As the geographic inter-relationships of the species are at present indeterminable all the forms discriminated are given specific rank. This is necessary as there are four distinct forms practically living alongside each other which have been commonly regarded as conspecific.

Two of these live on the coral reef, a large and a smaller one, and two corresponding appear to be restricted more to the mainland, the smaller one usually only dredged. The large coral reef shell is of the *velata* Sowerby appearance, the smaller one, the " *decussata* Sowerby " as shown by Reeve's figures. The large mainland shell has a thick periostracum recalling that of *lacerata* Reeve, but not so dense, and the small dredged mainland form is recalled by *lima* Reeve. These species are quite distinct in nature, and easily separated when collecting or handling fresh collections. All occur along the East Coast of Australia, probably representing different groups, but at the present time they are not generically separated, the distinguishing generic features not being understood. It may be remarked that the periostracum may later be used as the superficial differences are quite noticeable, the regularly spaced thick bristly periostracum contrasting vividly with the scant almost silky clad shell. The coral reef shell is here described, but the differences are much more striking in life than in literature.

Shell large, elongate, anteriorly a little produced and narrowed, posteriorly produced, swollen and broadened, the ventral margin sinuate near the anterior end, the posterior angle very rounded, posterior area large. Anteriorly there is no acute angulation and posteriorly the angle of junction is obtuse. The shell is fairly tumid, less so anteriorly, most swollen post median. The ligamental area is narrowed, completely covered with a thick black ligament very closely marked with black and white chevron lines. The sculpture consists of numerous distinct radials which are coarser and more nodulose on the anterior and become finer and more in number on the posterior area. On this area there can be seen a few remnants of a horny periostracum but the shell is otherwise naked. The byssal gape is long and narrow. The specimen figured, from Low Isles, measures 82 mm. in length, 48 mm. in height and 40 mm. in depth.

Arca multivillosa sp. nov. (Plate II, figs. 3, 3*a*.)

Shell large, elongate, moderately compressed, anterior angle sharp, posterior angle also sharp, ventral margin curved, sinuate, narrowing anteriorly then curving abruptly upward to meet the anterior angle ; sloping downward posteriorly and then curving round to run backward to meet the posterior angle sharply. Coloration white inside and outside, the latter covered with a thick flaky periostracum which is short and dense anteriorly and medially, becoming long and thick posteriorly, worn off in the middle umbonally. The sculpture consists of fine radials, which become coarser towards the posterior area, the posterior angle rounded, the area showing only a few broad flattened ribs. The teeth are few externally but many small ones still are seen medially. The specimen figured is from Keppel Bay, Queensland, collected by Mr. H. Bernhard and measures 64 mm. in length, 36 mm. in height and 30 mm. in depth.

Many shells appear in dredgings, which are like this species, but more regular in every way, smaller, the periostracum shorter, the posterior ribbing coarse but a little less

marked and the hinge teeth many and more regular. This is the form wrongly recorded as *lima*, and it may be regarded as a subspecies of the above with the name *Arca multivillosa antilima* subsp. nov.

Prashad (p. 42) included *Arca* (*Barbatia*) *decussata* Sowerby, with the explanation: " After carefully going through the earlier descriptions and the collections in the Indian Museum, Calcutta, and the Reevian types in the British Museum (Natural History), London, I have come to the conclusion that the limits assigned by Lamy to this speceis and to *A. nivea* are probably correct, and that Lynge, while treating *A. lima* as a distinct species, was wrong in uniting *A. relata* with *A. decussata.* I have no doubt that Lamarck's specimen of *A. trapezina* which was figured by Delessert and Dunker's *A. stigmosa*, *A. oblonga* and *A. petersi* are all to be referred to *A. decussata.* Distribution: *A. decussata* is widely distributed in the Indo-Pacific Ocean, and is often found attached to other molluscs."

In nature, from specimens collected in series and ecological studies, many species occur which in Museums are classed as *A. decussata*, and even the name *Arca decussata* Sowerby cannot be used, as there is a prior *Arca decussata* Linné (' Syst. Nat.' 10th ed., p. 694, 1758), as pointed out many years ago. The lengthened synonymy published by Prashad was evidently not compiled by himself as there are obvious inaccuracies, which are quite foreign to Prashad's general meticulous care.

As a variety Prashad (p. 44) recorded *Arca lima* Reeve with doubt as to its specific distinction. The species synonymized with both the species in general and the variety were allotted without consideration of geographical distribution, and consequently reconsideration becomes necessary in accordance with the results of this investigation.

Further, Prashad on the same page admitted *Arca grayana* Dunker as a distinct species with a short description of the shells he so determined. The most noticeable feature of *Barbatia* (not *Arca*) *grayana* Dunker is the dense " epidermis " and the fine sculpture with the locality " Ex Indiis misit clar. Gräfe ". Prashad translates the locality " Indian Ocean " and describes a sculpture of " round to rhomboidal nodules ", and his specimens had no " lamellose epidermis ". The identity is thus very doubtful.

Again, Prashad (p. 45) has figured (pl. i, figs. 58, 59) a specimen from Station 163 (near Seget, West entrance to Selec Strait) as of *Barbatia paulucciana* Tapparone-Canefri (' Ann. Mus. Civ. Stor. Nat. Genov.' IX, p. 292, 8th March, 1877 : Amboina). Lamy had placed this name in the synonymy of " *nivea* ", but Prashad disagreed, suggesting its nearer alliance to *A. decussata.* Judging from the figures and description I would regard it as immature, and nearer *A. adamsiana* Dunker than the others.

Arca parvivillosa sp. nov. (Plate II, figs. 4, 4*a*.)

Shell of medium size, smaller than preceding, more regular in shape; anterior side short but not narrowed, posterior side long and narrowed, the ventral edge not sinuate and the byssal opening very small. Outer coloration white, short-pointed, horny processes arising between the ribs only so that compared with the preceding this is a hairless form; inside white. The hinge is short and consequently the hinge teeth are fewer than in the preceding, numbering less than thirty large and small; sixty may be thus counted on the *multivillosa* hinge. The sculpture is more regular and the ribs are somewhat nodulose, especially the half dozen on the posterior area.

The shell figured is from North-west Islet, Capricorn Group, and measures 45 mm. in length, 27 mm. in height and 21 mm. in depth.

Arca prolatens sp. nov. (Plate II. figs. 5, 5*a*.)

Shell fairly large, elongately oval, produced at each end, anteriorly rather rounded, posteriorly angulately rounded, the posterior area sub-keeled, ventral edge medially sinuate, more swollen posteriorly; sometimes the reverse is the case, the ventral median area being produced, not sinuate, and at others the ventral margin is nearly straight. The sculpture is fairly uniform, fine ribbing extending over all the area, both anteriorly and posteriorly. The ribs are rather narrow, closely packed and subnodulose through concentric cutting of growth-lines. Along these growth-lines is produced narrowly elongate grooved horny periostracum.

Colour yellowish-white, posterior half reddish-white; the interior is reddish-white, posteriorly purplish-red. In the hinge only a few teeth remain at each end, the median series being entirely obliterated.

The specimen figured, from Caloundra, South Queensland, measures 52 mm. in length, 29 mm. in height, and 19 mm. in depth. There has been a lot of confusion regarding the species of Ark of this appearance in South Queensland, and it was only solved by careful collecting on the spot, when it was found that two similar species occurred together, one coming from the north, *multivillosa* of this essay, and the other from the south, the species here dealt with.

Shirley recommended the addition of *Arca carpenteri* Dunker to Hedley's Queensland List of specimens from Moreton Bay; probably the determination was due to Lamy, but Dunker's species was described (' Novit. Conch.' p. 86, pl. xxx, figs. 7–9, 1866) from the South Coast of New Holland, and would probably be the shell for which I (' Proc. Linn. Soc. N.S.W.' XXIV, p. 186, 1924) advocated the usage of *Arca pistachia* Lamarck (' Hist. Anim. s. Vert.' VI (i), p. 41, July, 1819: Timor and Ile King). Further experience of the difficulty of determining Lamarckian species suggested that this conclusion should be reviewed, but specimens from South Australia agree fairly. In every case the South Queensland shell is nameless as it is large, pale coloured, differently shaped, etc., from any of the southern forms. Hedley listed it as *Arca fasciata* Reeve, but that name is preoccupied. The Queensland shell is the northern representative of " *pistachia* Lamarck ," but curiously a series of small shells with similar features inhabits the Pacific. Specimens from the Paumotus agree with Sowerby's description (' Proc. Zool. Soc. (Lond.) ', p. 19, May, 1833) of his *Byssoarca parva*. Shells collected at Lord Howe Island are of similar superficies and reach a length of 16 mm., but Norfolk Island shells are smaller, none exceeding 9 mm., and the only two valves collected at the Kermadec Islands measure 8 mm. Prashad (p. 48) observes, " I agree with Lamy that it is not possible to unite (*Arca parva* Sowerby) with Lamarck's *A. pistachia*. . . . In the ' Siboga ' collection it is represented by young stray valves not exceeding 10 mm. . . . has been recorded from the Gulf of Suez, the Red Sea, Madagascar, Persian Gulf, Gulf of Siam, Tahiti, Ducie's Island, etc." Then under *Arca radula* Smith (p. 48) adds, " has so far been recorded from South Australia . . . there is a single specimen from near the Kei Islands (St. 260) which, after comparison with Smith's types, I assign to this species."

The range of *A. parva* from the Gulf of Suez to Ducie's Island is not confirmed in

any sense from study of these small Arks, and the nomination of a Kei Island shell with a name hitherto exclusively used for a South Australian species is conducive to very erroneous conclusions.

Genus *Savignyarca.*

1891. *Savignyarca* Jousseaume, Le Naturaliste, 13e Yr., V, p. 222, September.
Tautotype : *S. savignyarca* Jousseaume.

Jousseaume introduced his tautonymic genus for a form of Ark from the Red Sea, and some years afterward Lamy explained that the species was nothing else than *Arca obliquata* Gray, which Krauss had reported from South Africa, and that the genus was purely synonymous with *Barbatia* = *Arca.* Gray's name was published by Wood with an excellent little figure, and I collected shells agreeing very accurately with that figure on the beach at Colombo, Ceylon.

For this group *Obliquarca* Sacco (' I. Moll. Terr. Terz. Piemonte e Lig.' pt. 26, p. 16, December, 1898) introduced with orthotype the fossil *Arca modioliformis* Deshayes, has been used, but if the groups were co-equal, which I do not admit, Jousseaume's name has priority. The juvenile stage of " *obliquata* " is well differentiated from that of the *Arca* (=*Barbatia*) series, and the recognition of a deep-water form living alongside showing the juvenile features indicates the absolute distinction of the group. The juvenile already (13·5 mm.) shows the anterior attenuation and posterior broadening, the hinge line being comparatively straight but the terminal teeth with a definite downward tendency : these terminal teeth number five anterior and eight posterior large and sloping : across the hinge line between these range twenty-five to thirty minute perpendicular, almost peg-like teeth ; the ligamental area is very narrow, clothed posteriorly to the umbones with a thick leathery covering apparently grooved chevron fashion. The adult shows the attenuate anterior end still more narrowed and produced, but rounded, not angulate, and the posterior end still more broadened and rounded, the ventral side almost straight and very slightly sinuate for the byssus opening. The stout ligament persists after death so that conjoined pairs are often dead on the seashore, nearly all other Arks occurring only as separate valves when dead. The left valve exceeds in size the right and clasps it. A thick short periostracum covers the posterior end.

Savignyarca scazon sp. nov. (Plate II, figs, 6 6*a*.)

Specimens collected on the beach at Townsville closely resemble typical *Arca obliquata* Wood (' Suppl. Index Test ', p. 6, pl. ii, *Arca*, fig. 4, 1828) as collected at Colombo, Ceylon, and also are not much like Reeve's figures of *obliquata* or *obtusa.* These differ from Wood's figure in being less produced and less angulate anteriorly and much more swollen posteriorly. Compared with Reeve's *obliquata* our shell is narrower anteriorly, broader posteriorly and less sinuate ventrally. The Australian shell scarcely needs comparison with Reeve's *obtusa,* being so differently formed, the anterior part of Reeve's species showing little attenuation and the posterior little swelling.

Shell elongate, narrowed anteriorly, swollen posteriorly, hinge-line long, the anterior end a little produced and rounded, thence the ventral margin slopes away and then curving again comes back with a sweep and then angle to the hinge line. The sculpture is very fine radials with little cross sculpture and rather thickly covered with a dense,

short, flaky horny periostracum. Inside shining bluish white. The ligamental area is very narrow and completely covered with a thick strong ligament which holds the valves together a long time after death. A few long slanting teeth at each end, the median teeth obsolete.

The juvenile shell is more regular, the anterior end less narrowed and the posterior less swollen but still the general facies is recognizable easily. The periostracum is short between the anterior and median ribs, but on the posterior area the ribs are not well marked and there is a continuous horny covering showing six rows of produced spiny processes. The hinge shows also all the median minute teeth between twenty and thirty in number, while there are eight large posterior teeth and about six large anterior ones.

The measurements of the figured shell from Townsville are: Length 41 mm., height 25 mm., depth 16 mm.

Lamy's treatment of "*obliquata*" is difficult to understand. He allows *obliquata* Gray from South Africa, Red Sea and Madagascar. As a synonym he associated *Arca turgidula* Deshayes ('Mag. Zool.', Moll., pl. lxxxiv, 1844) from unknown locality. Deshaye's figure portrays a swollen shell with little anterior attenuation and a strong hinge line, which does not appear referable to *Savignyarca* at all. It also has strong sculpture whereas *obliquata* has fine. Lamy cited Philippi's figure and Koch's MS. name *carditaeformis* ('Abbild. Conch.' II, pp. 30–31, pl. ii, fig. 4, 1845) as the real *obliquata*, and these are very different from Deshayes' *turgidula*, the name signifying its swollen character, whereas *obliquata* as here understood is always very compressed. Then Lamy separated the Eastern form as a distinct species under the name *decurvata* Lischke. It is puzzling why this name was selected as it was merely brought in as a new name for *Arca obliquata* Reeve, from the Philippines. Reeve at the same time proposed *Arca obtusa* from Japan, and this has been regarded as the same Japanese species. As there was a prior *Cucullaea obtusa* Phillipps ('Geol. Yorksh.' II, p. 210, 1836) which Nyst referred to *Arca*, Nyst replaced Reeve's name by *obtusoides* ('Mém. Ac. Roy. Belg.' XXII, p. 50, 1848), under which name Hedley ('Proc. Linn. Soc. N.S.W.' XLVIII, p. 301, 1923) added the form to the Queensland List. Even if this were ignored, there is an *Arca sinensis* Philippi ('Zeitsch. für Malak.' VIII, p. 53, 1851) which appears to have claim before *decurvata* Lischke. It may be noted that Lamy has synonymized all these names.

Savignyarca benthicola sp. nov. (Plate II, figs. 7, 7*a*.)

A specimen dredged at Station XVII appears to be a deep-water relative of the preceding species but is less narrowed anteriorly and is more swollen throughout, more delicate shell and thickly clothed with a fine periostracum. The hinge is very much reduced, three weak but notable teeth persisting at each end, the long median series being almost obliterated, a slender roughened ridge alone discernible. It is almost the form of the juvenile described above but is much more swollen and the sculpture is very delicate. The valve measures 26 mm. in length, 15 mm. in height, and 6·5 mm. in depth.

Genus *Barbatirus* nov.

Type: *B. mimulus* nov. sp.

This is another of the "*Barbatia*" series, which has apparently developed nestling habits.

Shell elongate, practically equivalve, very inequilateral, anteriorly rounded, a little narrowed, posteriorly broadened, coloration unicolor, pallid, periostracum very thin, pale. Sculpture of longitudinal ribs scarcely nodulose through growth lines, anteriorly and medially ribs very fine, posteriorly becoming crass and thickened and rugose, almost spinose. The ligamental area is very narrow, covered with a coarse black leathery substance, showing transverse striae only. The hinge line is long, the teeth few, large and prominent at each end, a series of small denticles only between ; the posterior series number about six, three larger slanting outwards, straight, finely denticulate ; the anterior series are also few, eight to ten, also slanting outwards, nearly straight, a little curved, but not chevron-shaped, finely but notably denticulate ; the intermediate denticles cannot be accurately counted but may represent between twenty and thirty teeth, the point of separation between the anterior and posterior series of teeth not being distinguishable. The anterior muscle scar is rounded, the scar above short and rather broad, the posterior also rounded but small.

Barbatirus mimulus sp. nov. (Plate II, figs. 8, 8*a*.)

A curious shell recalling a " *Venerupis* " was found at Low Isles, and the only figure resembling it was that of *Arca cometa* Reeve ('Conch. Icon.' II, pl. xvi, sp. 111, May, 1844 : I. Luzon). Reeve's species has been recorded from New Caledonia so that probably the form under notice is intended by that record ; from the figure our shell is more finely ribbed medially and anteriorly and more coarsely ribbed posteriorly.

The shell is rather compressed, a little produced anteriorly, swollen and produced posteriorly, the posterior end broad but almost squarely truncate ; the coloration is greenish grey, the anterior and median portions finely radially ribbed, the rounded posterior angulation coarsely ribbed, the ribs sub-spinose ; the upper part of the posterior area is flattened and also coarsely subspinosely ribbed. Indications of a fine pale periostracum can be seen anteriorly but otherwise the shell shows no covering. The ligamental area is very narrow, the ligament thick and stout, teeth large, slanting, and denticulate at ends, six anteriorly, eight posteriorly, the outside teeth in each case tending to become horizontal ; medially there are many minute teeth still present but scarcely distinguishable. The figured specimen measures 25 mm. in length, 14 mm. in height and 11 mm. in depth.

Prashad (p. 41) recorded *Arca* (*Barbatia*) *cometa* Reeve with a note, " I agree with Lamy that *Arca cometa* should be placed in the subgenus *Barbatia* and not *Acar*, as Kobelt had done . . . the following notes on the type should prove useful . . . " but gives no details of the hinge teeth, nor ligamental area, so that nothing really definite has been yet recorded regarding this species.

Barbatirus terebrans sp. nov. (Plate II, figs. 9, 9*a*.)

This quaint little shell was found in holes in coral boulders, perhaps made by Date Mussels, but this was not proven. It appears to be closely related to the preceding but differs in shape, being more elongate, cylindrical in form, the anterior end more produced and rounded and similarly the posterior end lengthened. The coarse posterior sculpture of the preceding shell is much weakened and curiously the teeth are also very much weaker, the anterior series comprising six small perpendicular teeth showing no denticulation ; the median area almost smooth through the obtrusion of the ligamental area,

which is similar to that of the preceding species but is paradoxically comparatively broader, the umbones not approximating quite so closely as in *mimulus;* the posterior series of teeth numbering about nine, small, rather slanting outwards, denticulations obsolete.

The anterior and median sculpture is also much finer, the ribs much closer and showing an obsolete reticulation through the cutting by growth lines, which is absent in *mimulus*, as previously noted.

The specimen figured from Low Isles measures 20 mm. in length, 8 mm. in height and 7 mm. in depth.

Genus *Acar*.

1857. *Acar* Gray, Ann. Mag. Nat. Hist. 2nd ser., XIX, p. 369, May.
Logotype: Stoliczka, Palaeont. Indica, III, p. xxxi, 1871, *Byssoarca divaricata* Sowerby.

Small shells, solid and opaque, elongate oval, posteriorly keeled, equivalve, inequilateral, practically lacking periostracum; sculpture peculiar, strong radials cut into oblique lozenges by concentric grooves; ligamental area narrow, ligamental covering restricted to the posterior portion; hinge line a little curved, teeth not very numerous in distinct anterior and posterior series; muscle-scars large and subcircular; byssiferous, but byssal gape minute and ill-defined.

For many years the type of *Acar* was accepted without investigation, *plicata* being commonly cited, but Woodring, an independent worker, observed that *donaciformis* was inadmissible as it was not included among the original members of *Acar*. He concluded that no legitimate type had been selected so designated *A. gradata* Broderip and Sowerby. At once he was followed in his innovation by workers such as Cox and Prashad, each of whom might have recalled Stoliczka, whose meticulous work on Indian fossils is always worthy of reference, while he named many types. Ghosh, commenting upon the "Animal of *Acar* Gray", included "the only species, the soft parts of which are known to the science, viz., *A. tenella* Reeve, has been figured by Pelseneer ('Les Lamellibranches de l'exped. du Siboga', part anat., 61, Mon. 53*d*, 1911)". Ghosh's specimens were from deep water (regarded as *A. pteroessa* Smith), and his conclusions read: "Formerly united with *Barbatia*, Gray, as a section (or subgenus), *Acar*, Gray, has been separated by Lamy ('Journ. de Conchyliol.', LV, p. 210, 1907) from his study of shells only. The present study of the soft parts fully justifies his views. . . . It is highly suggestive that the wedge-shaped body, postero-ventral extension of the mantle lobes leaving wide space between them behind and below the gills (themselves curved posteriorly to make room behind) are correlated with deep-sea life of the animals of *Acar*, Gray."

All the members of *Acar* Gray are littoral species living between tide-marks, and not entering even shallow water, so that Ghosh's remarks are peculiarly inapplicable. It is therefore necessary to prevent confusion to separate the species dissected by Ghosh under the identity of *Arca pteroessa* Smith with the new generic name, *Indacar*. Ghosh's essay appeared in a rather unlikely place for the conchological student—the 'Indian Journal of Medicine', pp. 457–459, 1921.

Bartsch ('Proc. U.S. Nat. Mus.' LXXX, art. 9, pp. 1–4, 1931) has used *Acar*, quite correctly, generically, and Grant has commented ('Nautilus', XLV, pp. 127–8, April, 1932) upon this, suggesting it should be regarded as merely a group of *Barbatia*, but that was merely from the study of a local series. On that account Grant and Gale diagnosed

Barbatia as comprising " comparatively small " Arks, whereas many are very large, an Australian specimen from Caloundra, Queensland, measuring 112 mm. in length. Grant's suggestions regarding the usage of generic and subgeneric terms are very unconvincing as he wrote, " Perhaps *Acar* should be considered a distinct genus, but would it not be just as well to look upon it as a reticulated subgenus of *Barbatia*, with somewhat different shape and muscle scars ? "

Acar dubia Baird 1873. (Plate II, figs. 10, 10*a*, 10*b*.)

1873. *Arca* (*Byssoarca*) *dubia* Baird, Jottings Cruise Curaçoa, p. 453, pl. xlii, figs. 5, 6 : New Caledonia.

A small heavily sculptured Ark found under coral blocks belongs to a series (the genus *Acar* of this place) which has a most confused literary history.

Thus Melville and Standen recorded from Queensland *Barbatia* (*Acar*) *divaricata* Sow., and *B.* (*A.*) *domingensis* Lam. ; these were regarded as referring to lone species by Hedley, who referred both to the earlier *Arca plicata* Chemn. Unfamiliar with systematics, Shirley suggested as additions to Hedley's List *Arca pusilla* Sow. from Caloundra and *Arca reticulata* Sow. from Moreton Bay. All these relate to the same species as found in Queensland.

Lamy used the name *Arca plicata* Chemnitz for a " species " with world-wide range, collating therewith a long and varied synonymy. When series are contrasted, the differences become more marked than the similarities, and Hedley described the New South Wales form as *Arca botanica* ('Proc. Linn. Soc. N.S.W.' XLI, 1916, p. 680, pl. li, figs. 33–35, 4th April, 1917 : New South Wales = restricted locality, Port Jackson, whence figured specimen was collected).

The New Caledonian species is the nearest geographically to the Queensland shells, and shells from Low Isles, Michaelmas Cay, etc., are very like those from that locality. The ribs are few in number, the posterior area being divaricately ribbed. A median depression separates a heavily reticulate posterior section from the anterior section on which the concentric sculpture is less marked, the radials more notable forming marked nodules at their intersection. The largest shell measures 23 mm., and a series collected at the Kermadec Islands, Lord Howe Island and Norfolk Island have been compared. Those from the two latter places are scarcely separable from each other but are slightly smaller than the Australian ones, the largest being 17 mm., while the sculpture of the posterior area is more subdued so that the divaricate nature is less noticeable : the juveniles are elongate and slight but the adults are deep and swollen. These may be regarded as a subspecies, *Acar dubia digma* nov., the type being a Lord Howe Island shell. The Kermadec series is still less, the shells more elongate with the dorsal area sharply angulate, the sculpture on the posterior area finer and generally the sculpture is more regularly nodose. This appears to indicate a definite subspecies which may be called *Acar dubia kerma* nov.

Shells from Mangareva and Marutea in the Paumotu Group may be regarded as topotypical of *Byssoarca divaricata* Sowerby ('Proc. Zool. Soc. (Lond.)', p. 18, 17th May, 1833 : Annaa or Chain Island, Pacific Ocean) and these are very large for this group, oblong with the posterior portion swollen, the posterior area with a rounded edge, the posterior keel being spine-bearing with the ten divaricating posterior ribs crossed by

laminae; three distinct areas are seen, posterior heavily sculptured, the median lightly sculptured, the anterior nodulose. Nothing like this occurs in Queensland.

As regards the name *domingensis* Lamarck there is still confusion, so that it must be dealt with. Lamarck introduced *Arca domingensis* ('Hist. Anim. s. Vert.' VI, pt. 1, p. 40, July, 1819) for the West Indian shell figured by 'List. Conch.' t. 233, fig. 67, noting "Elle paraît différente de l'*arca reticulata* de Gmelin". Gmelin's *Arca reticulata* ('Syst. Nat.' pt. VI, p. 3311, 1791), however, was based on a similar species, of which the first illustration cited was Lister's as above, so that *domingensis* Lamarck becomes an absolute synonym of *reticulata* Gmelin, which must be used for the West Indian species.

Lamy did not differentiate the Atlantic, Indian and Pacific Ocean forms, but Prashad (p. 50) has used "*Arca* (*Acar*) *plicata* Dillwyn", unfortunately including under it, "1685. Lister, 'Hist. Conch.' pl. ccxxxiii, fig. 67", while observing, "I, however, agree with Cooke and Tomlin that there are three well distinguished forms; *A. gradata* Broderip and Sowerby from the West Coast of North America, *A. domingensis* Lamarck from the West Indies and *A.* (*A.*) *plicata* Dillwyn from the Indo-Pacific. He then gave a general description of the Indo-Pacific species: "is easily distinguished by its short and stout but not very swollen shell, the much fewer number of ribs, the central area with closely placed ribs, the ribs behind the keel running transversely outwards to the edge, the nodules on the ribs rounded and the ventral margin often distorted".

Arca plicata Dillwyn ('Descr. Cat. Rec. Shells', p. 227, 1817) was given to the shell described and figured by Chemnitz (XI, p. 244, t. 204, fig. 2008) from the Red Sea, and the name appears to be the earliest given to the Red Sea species.

Acar iota sp. nov. (Plate II, figs. 11, 11*a*.)

This is almost a miniature of the preceding, and is probably the smallest Ark yet described. It was found while breaking up slabs of beach rock at Low Isles, and the specimens were almost indistinguishable from the coarse grains of sand constituting the rock. The shells were obviously adult and the ligamental construction is that of *Acar*, the teeth being very few, four anteriorly, eight posteriorly. The specimen figured measures 3·5 mm. in length, 2 mm. in height, and 2 mm. in depth.

Shell small, stout, anteriorly a little pouting, posteriorly rather truncate, posterior angle shape, posterior area depressed.

Genus *Vitracar* nov.

Type: *V. laterosa* nov.

The vitreous appearance of this group separates it at sight from the thick opaque *Acar*, while its form, sculpture, ligamental covering and hinge teeth all show variation from those of that genus.

In shape the shell is elongately oval, the posterior end produced, and rather sharply angled, the umbones somewhat approximate, the ligamental area narrow, teeth numerous. Through living under rocks and in crevices the shell is sometimes unduly lengthened, and at others short and broad. but the general features are constant and make it readily recognizable.

Vitracar laterosa sp. nov. (Plate II, figs. 12, 12*a*.)

Shell small, inequilateral, equivalve, thin and vitreous, periostracum practically absent, compressed in youth but somewhat swollen in the senile state.

The anterior end is short and abruptly truncate, the posterior end lengthened and the posterior edge produced to a ventral angulation, the ventral margin very slightly curved and gently receding to the anterior junction. The sculpture consists of radial ribs, the ribs strongly beaded, the beads clearly differentiated though touching; these ribs number twenty-four in the young shell, the anterior and posterior ribs larger and more boldly beaded, the median ribs narrow; with age the median ribs become more numerous through intercalation so that thirty may be counted, the median series being somewhat uneven as to size. The umbonal areas show a median depression and the umbones are fairly close together, the ligamental area being narrow, attenuate posteriorly and narrowing anteriorly. The ligamental covering is very small and thin, being restricted to a small posterior section. The byssal opening is long and narrow, the byssus being also narrow and thin.

The specimen figured from Michaelmas Cay measures 17 mm. in length, 12·5 mm. in height and 10 mm. in depth.

A few valves were found on the beach and in dredgings at Low Isles, but many valves very variable in shape had been picked up at Michaelmas Cay, with one living shell found under a coral block. Some more living specimens have since been secured at Lindeman Island and these are very regular in shape, varying from 10 mm. to 19 mm. in length and from 6·5 mm. to 10 mm. in height, the depth of the largest specimen being 8 mm. An odd valve, however, measures 17 mm. by 11 mm. Lamy, dealing with Arks from Djibouti, Red Sea ('Bull. Mus. d'Hist. Nat. Paris', X, p. 275, fig. 2 in text, 1904), reported somewhat similar shells under the name *Arca* (*Acar*) *reticulata* Chemnitz, but in his later account (' Journ. de Conch.' LV, p. 90, 15th June, 1907) he questioned this association and used instead *Arca dichotoma* Deshayes ('Cat. Moll. Reunion', p. 22, pl. iii, figs. 18, 19, May, 1863) from the Island Reunion, but Deshayes' description and figures do not apply to the Australian shell under consideration.

Genus *Mabellarca* nov.

Type: *Arca dautzenbergi* Lamy.

Belonging to the *Arca-Acar* series from the nature of the ligamental area, but with different hinge teeth. The thin texture separates it easily, and the form approaches that of *Anadara*, the muscle-scars also recalling those of that group, while the few strong composite ribs are distinctive. Anteriorly there are many perpendicular teeth separated by a hiatus from twice as many outwardly-slanting teeth. Thus is would be difficult to incorporate this into any named group, Lamy describing it under *Anadara*, and Lynge regarding a very similar shell as *Scapharca*, from both of which the ligamental covering immediately distinguishes it. Smith described an *Arca consociata*, and similar shells are described hereafter and temporarily placed under this generic heading, but the chief differences are the larger size and simple, not composite, ribs.

Mabellarca dautzenbergi Lamy, 1907. (Plate II, figs. 13, 13*a*.)

Hedley added *A. dautzenbergi* Lamy to the Queensland list from Weary Bay, 8 fathoms, and Palm Islands, 15 fathoms. Lamy described the species ('Journ. de Conch.' LV, p. 232, pl. iii, figs. 9–11, 28th September, 1907) from the Ile Nou, New Caledonia, measurements reading 21 × 13 × 11 mm. and having 23 ribs. Specimens dredged at Low Isles 9–12 fathoms differ only in being deeper, measuring 17½ × 11 mm. though having the same number of ribs.

A similar shell was described by Lynge from the Gulf of Siam 6–30 fathoms as *Arca* (*Scapharca*) *dichotoma* Desh. var. *gratiosa* (p. 125, pl. ii, figs. 3, 4), and Lamy has noted its affinity.

Mabellarca dautzenbergi adjacens subsp. nov. (Plate II, figs. 14, 14*a*, 14*b*.)

A very beautiful little shell was dredged at Station V in 37 fathoms, obviously related to the preceding but being thinner, deeper, and more oblique. The ribs only number eighteen to twenty, each rib divided in the middle by a ditch though nodulous, the rather wide interstices striate, and with a delicate concentric periostracum between the ribs. The shell is greyish, the dead shells pure white inside and outside. The hinge line is straight, the teeth small and almost vertical, with little variation in size or form ; the anterior series numbers fifteen of similar size and vertical ; there is a hiatus between the series, the posterior numbering twenty-eight, slightly slanting, the median ones smaller.

The figured specimen measures 18 mm. in length, 13·5 mm. in height, and 11 mm. in depth.

Mabellarca ? disessa sp. nov. (Plate III, figs. 13, 13*a*.)

Valves among the dredgings from 9–12 fathoms, Low Isles, at first suggested *Imparilarca hubbardi*, but they were more rounded, the angular posterior rib was missing and both valves were nodulous. Somewhat similar shells from Mapoon were larger with other differences and had been recorded by Hedley as *consociata* Smith, and these are discussed in the following note.

The dredged valves are small and rather stout, a little oblique and suggest the juvenile of an *Anadara*, but do not agree with any of the numerous species studied. The valves moreover are very convex but there is no posterior keeling, while the ribs, which number twenty-four, are elevated, narrower than the interstices, nodulose, the nodules more marked anteriorly. The interstices are regularly striate underneath a thin, dark periostracum. The ligamental area is swollen anteriorly and only shows a narrow covering posteriorly, thus separating it from *Anadara*. The anterior hinge teeth number fourteen, vertical and separated by a hiatus from the posterior teeth, which number twenty-two and are on a slightly higher plane.

The valve figured measures 22·5 mm. in length, 15 mm. in height and 7·5 mm. in depth.

Mabellarca ? fortunata sp. nov. (Plate III, figs. 14, 14*a*.)

A specimen secured on the beach north of Cooktown recalled *Arca* (*Scapharca ?*) *consociata* Smith, but was much larger and there were many similar shells in the Museum collected by Hedley at Mapoon and thus determined. Smith's species ('Rep. Zool. "Challenger" ', XIII, p. 266, pl. xvii, figs. 7, 7*a*, 1885) was described from Station 189, Arafura

Sea, in 25 fathoms, green mud, and measured $12\frac{1}{2}$ mm. in length, $9\frac{1}{2}$ mm. in height, and $8\frac{1}{2}$ mm. in diameter. No details of the number of ribs nor teeth were given, and it was compared with *A. clathrata* Reeve from the Philippines.

The Mapoon series differs from Smith's description and figure: the shell is more elongate and regular, the ventral margin not curved but almost parallel with the hinge; the ribs are elevated, rather distant, number about twenty-five, the ribs nodulose, the nodules becoming obsolete on the posterior area, the interstices showing very faintly growth striae only. The ligamental area is expanded anteriorly, narrowed posteriorly and there a small ligament is seen, entirely behind the umbones. The anterior series of teeth is short, numbering thirteen, and the posterior series is about twice as long with about thirty-three teeth, the two series not in alignment, and a small tooth intervening.

The largest specimen (figured) measures 22 mm. in length, 15 mm. in height, and the single valve measures 8 mm. in depth.

I have since collected a series of valves from the beach at Seaforth, near Mackay, Queensland, and these agree generally with those from Mapoon but are larger, the largest measuring 34 mm. in length, 25 mm. in height, and single valve depth 13 mm. As it is a deeper and higher shell it may be named *M. ? fortunata pera* subsp. nov. The number of teeth in the hinge line has increased, the anterior series numbering twenty-one, there is a distinct hiatus with a median tooth, while the posterior series numbers forty-two. A dead shell trawled on the north side of Lindeman Island by Messrs. Whitley and Ward shows remains of a fine dark periostracum without any horny processes.

Genus *Miratacar* nov.

Type: *Arca wendti* Lamy.

Shell very small, elongate, inequilateral, inequivalve, sculpture of flattened ribs. The ribs finer medially, the ventral margin sinuate, the ligamental area with ligament behind the umbones. The hinge line very shallowly curved, teeth small, numerous. The superficies of a *Navicula*, which moreover does not clasp, with the ligamental covering of an *Acar*, demanded generic segregation, and then it was noted that the conservative Lamy had suggested this course.

Miratacar wendti Lamy, 1907. (Plate II, figs. 16, 16*a*, 16*b*.)

1907. *Arca wendti* Lamy, Journ. de Conch. LV, p. 45, pl. i, figs. 11, 12, 13, 15th June, *ex* Schmeltz MS.: Ile Nou, New Caledonia.

Schmeltz in the Godeffroy Catalogues recorded *Barbatia wendti* from the Ellice Islands as a *nomen nudum* only. Lamy, comparing with a specimen so labelled, used the Schmeltz MS. name for a New Caledonian shell which he figured in colour and well described. Hedley added it to the Queensland List from Hope Islands, and it was not uncommon as valves and a few complete shells in dredgings at Michaelmas Cay, while valves occurred at Low Isles.

The sculpture appears as about ten flattened ribs with threaded interstices on the anterior part, about twenty to twenty-five finer, closer ribs medially and ten to twelve larger flattened ribs posteriorly, the interstices not so strongly threaded. The coloration is white with yellow blotches. The hinge line is straight, the ventral margin almost

parallel but sinuate medially and the ends truncate. The sculpture on the left valve appears a little more distinctly. Although our shell is smaller, the figured specimen from Michaelmas Cay measuring 9 mm. in length, 4·25 in height and 3·5 in depth, it shows more ribs and may be called *Miratacar wendti michaelis* subsp. nov.

Prashad (p. 49) has recorded *Arca wendti* Lamy from off Labuan Pandan, Lombok (Station 34), and on the Borneo Bank (Station 80), observing—" In the 'Siboga' collection there are a number of shells from the localities enumerated, and which agree with a shell named *A. wendti* by Hedley, and now in the collections of the British Museum (Nat. Hist.), London. I am further of opinion that it is a true *Barbatia*. I publish photographs of a shell of the species (Plate I. figs. 60, 61)". Unfortunately these give only the outer surface of the shell and more depends on the hinge structure, but the reference to " *Barbatia* " suggests that his specimens belong to the " *wendti* " form.

Genus *Mimarcaria* nov.

Type: *M. saviolum* nov.

Among the small Arks regarded at first as *A. wendti* there occurred a very distinct little shell when it was isolated. A nice living specimen was secured at North-west Islet, Capricorn Group, and this has allowed complete diagnosis. Shell small, elongated, coloured inside and out, hinge line fairly straight, inequilateral, equivalve, with a fine periostracum. Sculpture of regular fine radials throughout. This small shell has the appearance of a miniature *Navicula* of the *imbricata* series but shows no byssal opening, and has the ligamental area with the ligament behind the umbones and the teeth are of the *Arca* (=*Barbatia*) style.

Mimarcaria saviolum sp. nov. (Plate II, figs. 15, 15*a*.)

The shell is pale brown outside, the posterior darker and inside pale brownish pink. Some dead shells appear blotched with brown, and these sometimes fade to yellowish and thus become confused with the preceding. The sculpture, however, is very distinct, being very numerous equal riblets, of which over one hundred can be counted, and these are cut into obsolete nodulation, a squarish style of nodules being seen on the posterior area; this is depressed and separated from the rather convex median area by a posterior angulation.

The hinge teeth are comparatively large, somewhat separated and slanting outwards, the external teeth being the largest; there is a hiatus with a small tooth separating the anterior series, which numbers about eleven teeth from the posterior series of about twenty-one teeth.

The figured specimen from North-west Islet, Capricorn Group, measures 12 mm. in length, 6 mm. in height, and 6 mm. in depth.

Genus *Thronacar* nov.

A very curious little shell was described by Smith (' Rep. Zool. Chall.' XIII, p. 263, pl. xvii, figs. 5–5*b*, 1885) as *Arca* (*Barbatia*) *corpulenta* from 1400 fathoms off Cape York, North Australia. Smith remarked that it was " very unlike the typical forms of *Barbatia* ", and might " (at all events for the present) be considered a very aberrant form of

that group ". It still appears on the Queensland List as *Arca*—a very misleading location —so is here given a new generic name, *Thronacar*, the features given by Smith being diagnostic. The shell is about subglobose, deeper than broad, a very unusual occurrence in the family, very thin with delicate teeth on a long hinge line, obsolete medially, and the ligament appears to be of the *Acar* style.

Genus *Ustularca* nov.

Type: *U. cruciata renuta* subsp. nov.

This genus is formed for the Ark commonly known as *Arca* or *Barbatia fusca*, which has peculiar features, its coloration being distinctive while its hinge line and shape do not agree with those of any named group. Somewhat roundly ovate, the shell is more symmetrical than *Barbatia* = *Arca* while the hinge line is distinctly curved, the curve dislocated medially. The anterior teeth number from six to twelve, the posterior series varying from twenty-four to thirty-six, a distinct hiatus between, the teeth marginad, larger and sloping, towards the umbo small and perpendicular. In old specimens the external teeth become irregular and broken. Coloration dark without and within. Sculpture finely nodulose. Anterior muscle scar small and rounded, posterior a little larger and more oval, the pedal adductor above but inward elongate. Ligament narrow with the form of that of the Barbatioid series. Byssiferous.

Ustularca cruciata renuta subsp. nov. (Plate III, figs. 1, 1*a*.)

1849. *Arca cruciata* Philippi, Abbild. Conch. III, *Arca*, pl. v, fig. 7, pp. 19–87, October : Indian Ocean.

When I recorded that *Arca fusca* Solander, 1786, antedated *Arca fusca* Bruguière, 1789, I did not suggest an alternative for the latter. Dall (' Nautilus ', XXXIV, p. 98, January, 1921) later stated that this was not necessary as both names related to the same Ark. This was purely an error, as the names refer to very different species. Bolten's *Arca amygdalumtostum* would come into use for the West Indian species, and Philippi's *cruciata* appears to be the earliest name given to an Indian Ocean form.

The Queensland shell is a common coral reef form, and is oblong oval in shape, sometimes ventrally sinuate, the umbones very anterior, approximate, ligamental area narrow, byssal aperture narrow, byssus small. Coloration dark blackish-brown outside sometimes showing a couple of diverging white rays from the umbones which disappear with growth ; inside unicolor dark brown, sometimes pale, with edges darker striae along inner edge of pallial line. The type, from Low Isles, measures 49 mm. by 30 mm.

The sculpture consists of closely set radial ribs cut by concentric lines into fine nodules, posteriorly a few ribs with larger nodules. Periostracum covering the shell, pale brown, elevated between the rows of sculpture into elongate flakes which may become gross and massed at the margins. The development of this periostracum seems to be erratic and may be governed by environmental stress. Overlooking the record of its preoccupation, Prashad (p. 45) has continued the usage of *Arca* (*Barbatia*) *fusca* Bruguière for the Indian Ocean shell, and has recognized *rodatzi* Dunker as a variety. The latter was described from Zanzibar and the colour variation is that seen normally in this group, so that it

cannot be used geographically, but the somewhat narrower hinge line is valueless in this connection. Apparently all Prashad's specimens would be referable to the typical *cruciata*.

Genus *Opularca* nov.

Type: *O. tenella egenora* subsp. nov.

The elegant Ark known as *Arca tenella* Reeve cannot be placed in any of the named groups, as though the ligamental area is covered after the style of that of *Acar*, the tenuity of the shell, its curious swollen method of growth and its hinge formation separate it. Pelseneer ('Siboga-Expeditie', Mon., LIII, Lamell. p. 13, 1911) has given an account of the anatomy of a species regarded as *tenella* Reeve, and Prashad (p. 53) has written, "I agree with Lamy that this species should be referred to the subgenus *Acar* and not *Barbatia*". The anatomy of *Acar* was not compared. Shell rather small, but thin, and swollen, sculpture very fine. ligamental area very narrow. The hinge teeth form a peculiar series: the anterior teeth are few in number (four to six), large and distantly sloping; the posterior teeth are mostly small and vertical until towards the margin a break occurs and the outside are larger, four appearing to be reinforced with a marginal base.

Opularca tenella egenora subsp. nov. (Plate III, figs. 2, 2*a*.)

1844. *Arca tenella* Reeve, Conch. Icon. II, pl. xiv, sp. and fig. 91, April: Burias Island, Philippines.

The Queensland shell lives all along the reef under coral blocks; it is easily differentiated from Reeve's form in being shallower, more elongate, and the striae mostly non-granulose. Lamy ('Journ. de Conch.' LV, p. 93, 15th June, 1907) recorded as a synonym of Reeve's species, *Barbatia mollis* Dunker ('Novit. Conch.' p. 92, pl. "xxx" =xxxi, figs. 2–4, 1867), from Fiji Islands, but that is more different still. Lynge (p. 117) figures a shell from the Gulf of Siam as *Arca* (*Acar*) *tenella* (pl. i, figs. 11, 12) which is quite unlike our shell in shape.

From North-West Isle, Capricorn Group, a very old shell, which measures 41 mm. in length and 21 mm. in height is 22 mm. in width; it has very fine, very numerous ribs, not granulose but with faint concentric striae; the shell is very obese and shows eight growth ditches. The specimen figured from the same locality measures 37 mm. in length, 20 mm. in height and 18 mm. in depth.

Genus *Trisidos*.

1798. *Trisidos* Bolten, Mus. Bolten, pt. II, p. 175, September.
Haplotype: *Trisidos arcatortuosa* Bolten.
1815. *Trisis* Oken, Lehrb. für Nat. III, (i), p. 236
Haplotype: *Arca tortuosa* Linné.
1850. *Parallelepipedum* Morch., Cat. Kierulf Conch. pp. 25–53, April, *ex* Klein *pre* Linnean.
Haplotype: *Arca tortuosa* Linné.
(Also spelt *Parallelipipedum*, *Parallelopipedum*, *Parallelipedum*, *Parallelipipedon*.)

The twisted Arks are sufficiently distinct to constitute a good group with more species and subspecies than have been hitherto recognized. It seems that *semitorta* may even be separable as a genus or subgenus as the juveniles show the adult form without any

material difference. Anton ('Verz. Conch.' p. 13, "1839", October, 1838) selected *semitorta* Lamarck as the genotype of *Trisis* Oken. 1815, but Lamarck's pecies was not described until 1819 so that the designation was invalid. The name *Epitrisis* is here proposed for *Arca semitorta* Lamarck, whose shell differs in shape and hinge features, as hereafter shown, from any of the species up to the present confused under the name *tortuosa* Linné.

To diagnose *tortuosa* first. The shell begins as a slightly abnormal Ark, the median depression of the umbones being more marked than usual; then as the shell grows the animal lengthens and also moves sideways so that a distinct twist appears and with age this becomes intensified, anteriorly the shell remains narrow but posteriorly it becomes swollen, and a posterior keel separates a rather broad posterior area. As the hinge rotates more pressure is stressed on the ligament, and the teeth weaken but still persist sloping at each end and becoming minute and obsolete medially.

In the case of *semitorta*, the shell begins with less abnormality but is much higher and stouter and the hinge line is distinctly shallowly curved, the teeth many and strong, the ligamental area narrow. The twisting with age is much less pronounced and the ligament does not gain power, the teeth retaining their size and strength and also their shallow curve.

In extreme cases, however, the teeth tend to disappear, and in a West Australian specimen of *tortuosa* the hinge now appears toothless—a remarkable anomaly.

Trisidos tortuosa Linné, 1758. (Plate III, figs. 8, 8*a*.)

1758. *Arca tortuosa* Linné, Syst. Nat., 10th ed., p. 693, January: Bonan kirch 2 t. 128; Rumph. mus. t. 47, f. K; Gualt Test t. 95, f. B; Klein ost t. 8, f. 16. No locality.

None of these early references show the strongly keeled shell as figured by Reeve ('Conch. Icon.' II, pl. xiii, fig. 86, 1844), though Hanley ('Ipsa Linn. Conch.' p. 91, 1855) wrote, "The *Arca tortuosa* of most writers still remains in the box marked for this species in the Linnean cabinet. The synonymy and very peculiar aspect facilitated its early identification". Hanley quoted Reeve's figure without comment as there was at that time no suspicion of confusion, but added, "'Latus superius laeve est' is the manuscript addition of our author in his revised copy of the 'Systema'".

Almost at the same time Mörch ('Cat. Conchyl. Kierulf', p. 25, 33 *ex* Steenstrup, *ante* 10th December, 1850) introduced *Arca* (*Parallelepipedum*) *torta*, *ex* Steenstrup MS. for *A. tortuosa* Enc. Méth non L.: "Differt ab *A. tortuosa* L. t. antice non producta angulo valvae sinistrae rotundato non carinato. Hab. ad Insulas Philippina. Kierulf." This name has been included as a synonym sometimes of *tortuosa*, at others of *semitorta*, indicating its distinction. Specimens in the Australian Museum from North-West Australia differed at sight from the so-called *tortuosa* of the East Coast, and were not really much like *semitorta*, also an East Coast shell, the former living near the mainland, the latter more often in the reef dredgings. Investigation suggested that this West Australian shell was more like the missing *torta* than any other shell, but then it was found that all the early figures really represented this form in preference to the acutely angled shell. Comparison of specimens and study of literature indicated that there were at least three distinct series of Twisted Arks, the "*semitorta*", the "*torta*" and the "*tortuosa*" forms. That the latter two are distinct is shown by their acquisition from the

same locality and easy differentiation. The determination of the type locality of Linné's species depends on Bonanni, who called it "Ostreum papuanum", and Rumph adds that this same shell comes from the Papuan Island "Messoal", *i. e.* Mysol: Rumph's figure, also Bonanni's, agrees with the "*torta*" form and certainly not with the Reevean picture. As Morch's "*torta*" was described from the Philippine Islands it is interesting to read Makijama's description of his *Arca kiyonoi* from Japan ('The Venus', II, pp. 269–277, figs. 1–8. August, 1931), which is undoubtedly closely related to the Philippine Island "*torta*", and should have been compared with it: but the latter appears to have been entirely overlooked.

Lamy admitted two species, *Arca tortuosa* Linné and *A. semitorta* Lamarck. Of the former he allowed *torta* Steenstrup as a variety, citing as synonym of the latter *fauroti* Jousseaume. As the range of the variety he gave only Aden (*fauroti*) and Annam, while for the typical form of *tortuosa* he cited Zanzibar, India, Malacca, Siam, Cochin-China and China.

Criticism of specimens in this Museum showed that each locality gave notable differences and that a large number of forms might be recognized, even among the few specimens available. Thus a shell from the Red Sea representing *fauroti* Jousseaume cannot be confused with any of the others. It is small, only 53 mm. long but solid and apparently well grown, not a juvenile; the posterior angle is quite rounded and the posterior area rather small, but with the radial sculpture pronounced though the sculpture as a whole is rather weak. The hinge teeth are numerous, strong, regular, slanting a little on each side away from the median series, which consists of about a dozen short vertical teeth somewhat degraded and being obliterated by the intrusive ligamental area: about fifteen teeth can be counted on each side.

A series from Madras and Ceylon are in agreement with the figures and descriptions of the authors quoted by Linnaeus for his *Arca tortuosa*, and show the posterior area practically smooth as noted by Linné in his MS. addition. These shells are more compressed than the Red Sea shell, are larger and deeper, the posterior area larger and the angle more pronounced, but not sharply angulate; the general sculpture is also much stronger. The hinge teeth are well defined with a small median area showing a few degraded teeth, the anterior series with about fifteen definite teeth and three or four medially indistinct, the posterior series about twenty slanting much more.

Specimens from Singapore differ at sight from the Indian ones in having the posterior area strongly radially ribbed and posterior angle continuously roundly angulate though prominent. The shell is of medium size, about 69 mm. in length, and is comparatively less swollen than the Red Sea *fauroti*. The hinge teeth appear to be stronger than those of the preceding form, the posterior series notably less slanting and less than twenty, the median series almost obsolete, and the anterior twelve lateral teeth large and thin, the inner half dozen small and crowded. Labelled as from Malacca we have two large strongly angulate shells, the posterior area very large and strongly radially sculptured, the posterior angle sharp and subspinose. This agrees well with Reeve's Fig. 86 save in the coarser sculpture of the posterior area and the hinge teeth are not so notable, the ligamental area encroaching more. The whole facies suggests that these have been living inshore and not dredged in 7–10 fathoms as Cuming's specimens were.

Crosse and Fischer ('Journ. de Conch.' XXXVII, p. 291, 1st October, 1889), writing on the marine mollusca of Annam, recorded "*A. tortuosa* var. β *Arca torta*. . . . Les

exemplaires de l'Annam se rapportent tous à la variété *torta*, remarquable par sa forme moins allongée, son côte anterieur plus arrondi et moins attenué ". This was included by Lamy under *torta*, but specimens from Cochin-China were classed under *tortuosa*. This suggested the distinction between the two must be specific and this is clearly seen by study of Australian specimens, where we find the two species, *torta* and " *tortuosa* ", as well as *semitorta*, but as mentioned above *torta* is the true *tortuosa* and " *tortuosa* " must be renamed, and I therefore provide *yongei* in honour of the leader of the Expedition. Then we can name the varying forms differentiated above as follows :

Trisidos tortuosa tortuosa Linné	Mysol.
addita nov.	Singapore.
Medium, posterior area sculptured.	
cingalena nov.	Ceylon.
Small, posterior area smooth.	
fauroti Jousseaume	Red Sea.
Small, posterior area sculptured.	
kiyonoi Makiyama	Japan.
Trisidos tortuosa torta Mörch	Philippines.
Trisidos yongei yongei nov.	Australia.
Large ; posterior area weakly sculptured.	
archeri nov.	Malacca.
Large ; posterior area completely sculptured.	
reevei nov.	Philippines.
Large ; posterior angle strongly prickly.	
lamyi nov.	Cochin-China.
Medium ; posterior area distantly ridged.	

Trisidos yongei sp. nov. (Plate III, figs. 3, 3*a*.)

Shell, large, twisted, right valve with a strong medial sinuation, clasped by left valve, which has the posterior area separated by an acute elevated keel ; hinge area narrow, almost linear ; sculpture of fine radials, interstices closely threaded. Coloration white, left valve showing very little periostracal covering ; right valve mostly clothed with a fine silky brown periostracum, thicker at the edges.

The sculpture is weaker on the right valve, and consists of fine radials which are strongly crenulated on the anterior but plain posteriorly with the submarginal series again cross-sculptured ; the ribs in the medial groove are more delicate. On the left valve the ribbing is more pronounced and the interstitial threading produces a minutely cancellate appearance, although intercalating finer ribs tend to subdue the cancellation ; the posterior area is finely closely rayed, but the ribs are flattened and there is no cancellation nor interstitial ribbing. The hinge teeth are almost obliterated medially and slope away at each end, varying in number with age ; the anterior series shows eight or nine distinct teeth, the posterior about twelve in the medium-sized specimen figured, which measures about 75 mm. in length, about 40 mm. in height, and about 28 mm. in depth. Shells reaching over 100 mm. in length are not uncommon. The type is from Port Curtis.

Trisidos semitorta Lamarck, 1819. (Plate III, figs. 4, 4*a*.)

1819. *Arca semitorta* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 37, July: " Mers de la Nouvelle Hollande à la terre de Diémen. Péron."

The locality is not quite correct, and probably means Shark's Bay, West Australia, or even Java. The species commonly occurs in dredgings off the coral reefs of Queensland, and we know Péron dredged in Shark's Bay.

Reeve figured a specimen from the Philippine Islands, and this has been accepted as typical by Lamy. It is somewhat curious that although the Twisted Arks differ appreciably, there is no note of their distinctive habits, the large angulate " *tortuosa* " being found on the mainland, while *semitorta* belongs to the Coral Reef fauna, whence it is commonly dredged, as at Low Isles, 9–12 fathoms. The hinge teeth meet at an angle in the juvenile shells, and then there are about ten teeth both anteriorly and posteriorly; very soon the posterior teeth number twenty while the anterior have only reached fourteen teeth ; a medium shell has the teeth increased to twenty-five posteriorly, twenty anteriorly. Then the ligament encroaches until the median teeth are almost obliterated, and the teeth at both ends become large and irregular, the posterior reduced to twelve, the anterior being about fourteen massed and broken. In this valve from Friday Island, Torres Straits, the length is 102 mm. and the height 55 mm.

The specimen figured, from Low Isles, is only a small shell measuring 50 mm. in length, 34 mm. in height, and 18 mm. in depth. The twist is comparatively slight, the ligamental area very narrow; the ligament has not yet extended beyond the umbones, having begun posteriorly as in *Acar* ; in the old shells the ligament covers the area and is deeply chevron marked. The right valve is well covered with a thick silky flaky periostracum and is much less and clasped by the left which is more strongly sculptured and shows little remains of any periostracum. It is possible that this species is restricted to Australia, though Lamy's range reads—" Se trouve dans l'Océan Indien, à Aden, au golfe de Siam, aux Philippines, au détroit de Torrès et au nord de l'Australie (Port Essington) ". The Aden locality given by Smith refers to *fauroti*, while the Gulf of Siam shells are of the " *torta* " style, not *semitorta*, and " the Indian Ocean " is valueless as an exact locality.

Genus *Anadara*.

1847. *Anadara* Gray, Proc. Zool. Soc. (Lond.), p. 198, November, 1847.
Orthotype : *Arca antiquata* Linné.

1838. *Rhomboides* Anton, Verz. Conch. " 1839 ", p. 12 (October), *ex* Blainville, Dict. Sci. Nat. (Levr.) XXXII, p. 321, 1824, vernacular only.
Orthotype : *Arca antiquata* Linné. (Not *Rhomboides* Goldfuss, 1820.)

1857. *Cara* Gray, Ann. Mag. Nat. Hist. ser. 2, XIX, p. 371, May.
Logotype : Stewart, Spec. Publ. 3, Acad. Nat. Sci. Phil, p. 86, 1930. *Arca aviculoides* Gray.

1857. *Rasia* Gray, Ann. Mag. Nat. Hist. ser. 2, XIX, p. 371, May.
Logotype : Stewart, Spec. Publ. Acad. Nat. Sci. Phil. p. 86, 1930. *Arca formosa* Sowerby.

1925. *Diluvarca* Woodring, Contr. Geol. Palaeont. West Indies, Carnegie Inst. Pub. 366, p. 40, 20th May.
Orthotype : *Arca diluvii* Lamarck.

Sherborn ('Index Anim.' II, Add. and Corr., p. 14) has included "*Anadara* Deshayes (*ex* Adans.) 'Ency. Meth.' (Vers.), II, (i), 1830, 37. L. [*teste* Nomen. anim.]". It is unfortunate that the compilation of the 'Nomenclator Animalium' was not entrusted to

competent hands, as Deshayes includes " *Anadara* " as a name given by Adanson "to a shell of the genus *Arca* ".

In a Special Publication No. 3 of the Academy of Natural Sciences of Philadelphia issued 9th August, 1930, Ralph B. Stewart discussed " Gabb's California Cretaceous and Tertiary Type Lamellibranchs ". Of especial interest to all taxonomists, neontologists as well as palaeontologists, is the excellent essay under the heading " Nomenclature ". Therein he reviews type designation and advocates the acceptance of Schumacher, especially in the case of *Arca*, but I cannot agree yet. Schumacher (' Essai nouv Syst. vers test ', p. 171, 1817) divided *Arca* Lin. into two sections, inaequivalvia and aequivalvia ; the former he again subdivided into two with species *Arca rhomboidalis* Chemn. for the first, *A. tortuosa* Lin. for the second ; then aequivalvia was also subdivided into two but these two were again divided into two, citing *Arca granosa* Lin. and *Arca lactea* Lin. in the former, *Arca barbata* Lin. and *Arca noae* in the latter. Then he wrote, "Pour le type du genre j'ai donné la fig. 2, Pl. xix, de la charnière de l'*Arca antiquata* Lin. qu'on trouve figurée dans Chemn. 7, pag. 201, Tab. 55, fig. 548 ".

It must be obvious that here " Pour le type " means simply " As an example ", and this can be confirmed by reference to p. 108, where in connection with the genus *Perlamater* Schumacher wrote, "Pour le type de ce genre j'ai donné deux figures, comme il y a une différence dans la largeur des fossettes ".

Stewart on the same page (p. 33) as he dealt with Schumacher refers to a paper by Schmidt which he concludes contains many type designations. He suggests it may be rare so gives a few notes, but many more are necessary, as this particular paper has been hitherto unknown and regarded as MS. only, our only information being the sketch given by Moller in the ' Isis ', 1832. The name *Trimusculus* has always kept Schmidt under notice, but Stewart's is the first record of the sight of a work lost for one hundred years. As Stewart states that Schmidt " suggested that there should be three types for each genus, including a *maximum* and *minimum* type which would indicate the limits of the genus ", I am not accepting Schmidt as a type designator under the present laws. Stewart wrote, " Schmidt designated *Arca noae* as type species of *Arca* Lamarck ", but this does not really concern us at all, as Linné is the authority for *Arca* and only type designations of Linné's *Arca* are of any value.

The *Anadara* series must be later split up so that the species can be easily recognized. At present we do not know enough about these Arks to define all the groups, but allowing *Anadara* for the shells with practically equivalve shells, rather squarely elongate, many flattened non-nodulous ribs, many hinge teeth, hinge line straight, then we can separate as—

Inequivalve, stout, inequilateral, sculpture discrepant, teeth fairly numerous and strong, ligamental area broad . . . . *Imparilarca.*
Inequivalve, thin, rather globose, large, sculpture little discrepant, teeth numerous, ligamental area narrow, periostracum dense. . *Scapharca.*
Inequivalve, solid, somewhat globose, small, sculpture discrepant, ligamental covering without chevron markings . . . . *Potiarca.*
Inequivalve, solid, elongate, sculpture of few nodulose ribs . . . *Tegillarca.*

The species of *Anadara* are difficult to separate in literature, though comparatively easy in life ; thus :

Large, coarse ribbing, between thirty and thirty-five—		
	ribs simple	*maculosa.*
	ribs divided	*suggesta.*
Large, fine ribbing, between forty and forty-five—		
	shell regularly oval	*crebricostata.*
	shell anteriorly narrowed, swollen posteriorly .	*exulta.*
Medium to small:		
Medium, posteriorly swollen, adult shell oblique, always much longer than high		*trapezia.*
Medium, no posterior swelling, nodulation notable, as high as long .		*nicholsoni.*
Medium, posteriorly truncate, sculpture distant, non-nodulose ribs, as high as long		*passa.*
Small, stout, rather short, ribs fine, closely packed, teeth many . .		*nugax.*
Small, thinner, longer, ribs comparatively few, teeth numerous . .		*jurata.*
Medium, thin, suboval, ribs not many, narrow, anteriorly sub-nodulose, teeth not many		*addita.*

Anadara maculosa Reeve, 1844.

1844. *Arca maculosa* Reeve, Conch. Icon. II, pl. iv, sp. 24, January ; North Coast of New Holland.

Many years ago Smith ('Proc. Zool. Soc. (Lond.)' 1891, p. 431) concluded that this species was not recognizable as it was based upon a variety of *antiquata* Linné, but did not determine what Linné's species was. As at the present time there has been much discussion about the status of Linné's species it becomes necessary to use Reeve's name for the shell previously listed as *antiquata.*

The Low Isles shells were found among weed on the flat near the mangroves and showed no byssus. The ribbing is very oblique and the ribs number thirty-five. The hinge-line is practically straight, a little curved at the ends, the teeth numbering sixteen to eighteen anteriorly, horizontal and close together, a medial tooth ; posteriorly the teeth number eighteen to twenty-five, not so close together as the anterior ones and slanting outwards ; with age the posterior teeth increase in number and the anterior decrease through the ligament encroaching.

Lamy (' Journ. de Conch.' LV, pp. 199 *et seq.*, 1907) has allowed *A. antiquata* Linné = *maculosa* Reeve and *transversalis* H. Adams with varieties *crenata* Reeve, *rugifera* Reeve, *amaliae* Kobel, *subrubra* Dunker, *scapha* Meuschen = *lamarcki* Phil. and *hankeyana* Reeve.

Such a confusion of species and localities must inevitably lead to chaos, and the first step necessary to avoid complexity is the correct delimitation of *antiquata* Linné. This name was introduced in the tenth edition (p. 694) with the diagnosis. " A. testa oblique cordata multisulcata sulcis muticis, natibus recurvis, margine crenato " and the locality " O. Americano ". The references read, " Bonan. recr. 2 t. 74, Rumph. mus. t. 44, f. I. Sloan jam t. 241, f. 14, 15, 16, and Gualt. test t. 87, f. C."

Bonanni's figure is not recognizable as any species commonly referred to as *antiquata.* Rumph's shell came from Amboina, thus disagreeing with the stated locality, and is a more square shell recalling the " scapha " rather than the traditional " antiquata ".

Gualtier's figure, without locality, is also much more regular than our " antiquata ", and was also described as " cuticula rufa vestita ", which also does not apply. This leaves the only reference that can be reconciled with the given locality as " Sloan jam t. 241, f. 14, 15, 16."

Hanley (' Ipsa Linn. Conch.' 1855) working differently recorded (p. 93) that a marked example of *Arca antiquata* was still preserved in the Linnean Cabinet and remarks upon the " great incorrectness of the synonymy ", and figured the " type " on pl. 4, fig. 3, and referred it to *maculosa* Reeve, on Cuming's authority. Reeve's *Arca maculosa* (' Conch. Icon.' II, pl. iv, f. and sp. 24, January, 1844) was described from " North coast of New Holland ", and Reeve's figure does not exactly agree with Hanley's illustration, and the Linnean specimen certainly did not come from New Holland, at least the east side. If " O. Americano " is to be rejected, the exact locality of the type shell must be determined by comparison and study of series, and Linné's shell will probably be found to be a native of Ceylon. This place was the source of much of Linné's material, and the figure cited agrees better with specimens from Ceylon than from Australia. Under the circumstances I would prefer the recognition of the locality as of importance and determine Linné's *Arca antiquata* as the American shell figured in Sloane's ' Jamaica '. Whichever view may later be adopted the specific name *antiquata* Linné is not applicable to any Australian shell, and *maculosa* Reeve appears to be the earliest name available. Baird's *novaecaledoniae* (' Cruise of the " Curaçoa " (Brenchley) ', p. 452, pl. xlii, fig. 4, 1873) seems inseparable.

Accepting the Ceylon shell as representative of Linné's *antiquata* the generic name *Anadara* must be used for the largest group of species of Arks, and which may later be found to include diverse elements. The shape is broadly oval, anteriorly a little narrower, and posteriorly broadening, fairly swollen medially, a posterior angulation delimiting a flattened posterior area ; the umbones are incurved towards the anterior end and the ligamental area is narrow, covered with a leathery skin which cracks transversely and only shows the diagonal grooving obscurely ; anteriorly the ligamental area widens a little. The umbonal area is characterized by a distinct medial depression which disappears with age. The shell is inequilateral but equivalve and covered with a thin brown periotracum, the shell itself being white inside and out, the interstices between the ribs being filled with elongate horny processes. The ribs are flattened, broader than the rather narrow interstices, and becoming wider on the posterior area.

The hinge-line is straight, the teeth numerous, small and vertical, the posterior ones sloping outwards, larger and a little separated, the anterior taking on a chevron shape, but there is no distinct separation of the posterior and anterior series. The internal edges of the valves are fluted, corresponding with the external ribbing. The posterior muscle scar is obliquely squarish, larger than the subcircular anterior one.

Series of the so-called " *antiquata* " show local variation but it is so slight that it cannot be easily written down, though it is indicative of the fact that geographical range must be considered. Thus mainland shells are slightly different in shape from those of the reefs, and these latter are very similar to those from New Caledonia. Fiji specimens are again like those of the last-named place, and Tonga ones are not very unlike. Yet the Tonga specimens look different when placed alongside a series from the Queensland Reefs. Another series from Southern Papua appears strange at sight, yet the individuals show very little appreciable distinction from those from the Queensland reefs.

Anadara suggesta sp. nov. (Plate III, figs. 5, 5*a*.)

Apparently representing the coral reef "*antiquata*" would be the form known as "*scapha*". Behind Cape Bedford, North Queensland, a shell was collected from a heap the animals of which had been eaten by aboriginals. Upon comparison it was found to be less oblique than the reef shells, and while the ribs numbered about thirty each rib was divided by a deep narrow ditch, the interstices narrow with rather notable striae. The ligamental area is comparatively wide, the umbones rather distant, the covering being chevron-marked as usual. The hinge line is nearly straight, the teeth strong and vertical, about twenty-five posteriorly and thirty anteriorly with a small median tooth. The figured specimen measures 67 mm. in length, 50 mm. in height and 50 mm. in depth.

Some mainland shells agree with this but others are more like *maculosa* Reeve, but none of the coral reef shells is of this style.

Lamy ('Journ. de Conch.' LV, p. 206, 25th September, 1907) stated that *A. novaecaledoniae* Baird from New Caledonia should be reunited to *A. scapha*, which he makes a variety of *antiquata* Linné. Baird's species belongs to the "*maculosa*" series, but I have seen "*scapha*" shells from New Caledonia.

Arca scapha Meuschen has been used, *e. g.* by Lamy, for a similar shell in which the ribs are divided by a median narrow groove, but the figure in the 'Zoophyl. Gronov.' fasc. III, pl. xviii (or i), f. 13, 1781, does not show such a groove nor does the description (p. 274) mention it, and the locality is given as Ceylon. This name would become available for the Cingalese "*antiquata*" if the Linnean name *antiquata* be restricted to the West Indies. As a synonym of his var. *scapha* Lamy has admitted *lamarcki* Philippi ('Arch Naturg.' (Wiegmann), XI, p. 55 (p. 142), 1845) from the seas of China, but that name can be allowed for the Chinese shell whatever it is. There can be no hesitation in admitting also *rugifera* Dunker from Zanzibar and *subrubra* Dunker from the Philippines after the former has been contrasted with *hankeyana* Reeve from Mozambique, while *transversalis* H. Adams from the Red Sea cited by Lamy as an absolute synonym of *antiquata* typical does not appear to be related closely to this series. Reeve's *crenata* was from unknown locality and the figure does not coincide with any of the forms above named, and must be placed on one side until long series are studied.

Kobelt's *Arca amaliae* ('Syst. Conch. Cab.' [Mart & Chemn.] cont. Kuster, VIII, heft x [363^{e} lief.], p. 26 [*ante* October], pl. viii, figs, 1, 2, 1888) from unknown locality belongs to the "*scapha*" series and may be from East Africa, as it recalls *hankeyana* Reeve in sculpture.

Anadara crebricostata Reeve, 1844. (Plate III, figs. 9, 9*a*.)

1844. *Arca crebricostata* Reeve, Conch. Icon. II, pl. ix, sp. 61, March : No locality.

When Reeve described this species he wrote "ribs more in number than in any other of the genus, three or four and forty in number", though just previously he had given *vellicata* as having ribs upwards of fifty in number. Lynge (p. 123) recorded this species from the Gulf of Siam, observing that though Reeve stated the number of ribs to be 43–44 the figure only showed 35–37, and his specimens only about 35.

In all probability Reeve's specimen was a Queensland shell and many specimens have now been seen from Keppel Bay, and Seaforth, north of Mackay, places collected at by the early voyagers such as those of the "Rattlesnake" and "Fly".

The Seaforth series ranges from 30 mm. in length by 20 mm. in height and 16 mm. in depth, to 81 mm. in length by 56 mm. in height and 25 mm. in depth, the ribs constant in number, forty-two or forty-three, and in form also, being flattened; square interstices narrow, less than half the width of the ribs; the teeth slightly disrupted medially, twenty-six anterior and thirty-two posterior, the former crowded medially, the latter more distant and separating and slanting marginad, the ligamental area narrow.

Anadara exulta sp. nov. (Plate III, figs. 7, 7*a*; figs. 12, 12*a*.)

Shirley recorded *Arca vellicata* Reeve from the Elliott River, North Queensland, as so determined by Lamy. A fine living specimen (figured) from the Albany Passage, 9–12 fathoms, and some valves from Caloundra, Queensland, at once recall Reeve's figure ('Conch. Icon.' II, pl. v, fig. 33, February, 1844: No locality), but Reeve stated that the ribs in his species were upwards of fifty in number; in the Queensland shell the ribs only number forty-two to forty-four, the shell measuring 54 mm. in length by 38 mm. in height and 32 mm. in depth.

A valve dredged off Low Isles in 9–12 fathoms is figured on Plate III, figs. 12, 12*a*, but a series since secured by dredging at Lindeman Island has shown it to be the immature of this species.

The juvenile is much compressed while the adult is swollen, but the number of ribs are the same in each case, the teeth numbering about twenty-six anteriorly and forty posteriorly with two or three broken teeth medially.

Anadara trapezia posita subsp. nov. (Plate III, figs. 6, 6*a*.)

1839. *Arca trapezia* Deshayes, Revue Zool. (Cuv.) II, p. 358, December. "Semblas" error = Sydney, New South Wales.

1844. *Arca lobata* Reeve, Conch. Icon. II, pl. iii, sp. 19, January. "West Indies" error = Sydney, New South Wales.

The well-known "Sydney Cockle" has a long history which has been completely recorded by Hedley ('Proc. Linn. Soc. N.S.W.', pp. 203–207, pl. ix, figs. 29–34, 1904) under the name *Arca lischkei* Dunker with a range from Bass Straits to Moreton Bay.

The Moreton Bay shells are rather short and stout and some specimens agree superficially with *Arca bicors* Philippi ('Abbild. Conch.' II, pt. 1, p. 32, pl. ii, fig. 6, 1845, *ex* Jonas MS.) described from the Indian Ocean, and since recorded from Moreton Bay by Shirley, perhaps on Lamy's determination as Shirley sent some Arks to Lamy for nomination. The Philippian shell is, however, quite distinct, and the majority of the Moreton Bay shells are quite unlike Philippi's figure. Indeed some appear to be leading to the crass valve I named *Anadara nicholsoni*, and if this be later shown that name would be available. However, further north a small regular shell allied to *trapezia* occurs which is described thus:

Shell of medium size, oblong, swollen posteriorly, obese, white. The sculpture consists of about twenty-seven subnodulose ribs, narrow deep interstices, periostracum thick, brown; teeth large, perpendicular, crenulate, of similar size, outer a little larger; anterior series numbering about twenty-two, posterior twenty-four, shell measuring 39 mm. in length, 34 mm. in height and 34 mm. in depth. The posterior area is steep and not

much expanded laterally, so that the obliquity of the typical form is missing and the shell is altogether more regular.

Hedley ('Proc. Linn. Soc. N.S.W.' p. 203, pl. ix, figs. 29–34, 10th May, 1904) discussed the species *trapezia* under the name "*lischkei*", and gave a series of figures showing the development in shape and hinge features from juvenile to adult. The senile state is much more oblique than in the adult form shown, and while in this stage it is quite equivalve, it begins life notably inequivalve, though the sculpture of the valves can scarcely be called discrepant. In the juvenile the hinge teeth are few and in two series widely separated while in the adult they are many, "twenty-one anterior and twenty-six posterior" with "a sharp break of gauge in the centre".

Anadara nicholsoni Iredale, 1927.

1927. *Anadara nicholsoni* Iredale, Austr. Zool. IV, p. 332, pl. xlvi, figs. 6, 13, 18th May: Caloundra, Queensland.

This extraordinary shell may turn out to be an extreme form of *A. trapezia* Deshayes, but it seems doubtful, as at Sydney, where the shell is numerous, nothing at all like it has yet been noticed.

Anadara passa sp. nov. (Plate III, figs. 16, 16*a*.)

A very thick shell was picked up from material dumped from dredgings off Cairns, North Queensland. This is figured as above, and a couple of valves have since been secured at Port Curtis.

Shell of medium size, squarish, very obese, posteriorly strongly angulate, posterior side very steep and short, inequilateral, equivalve, stout, umbones much incurved, ligamental area broad, slanting steeply inwards.

The sculpture consists of narrow ribs with deep interstices as wide as ribs, the interstices finely threaded; the ribs number twenty-eight, those on the right being plain, and those on the left faintly but scarcely nodulose. The hinge area is thickly chevron-marked, and the teeth are large and crass at each end, but small and delicate medially, six large and eleven small constituting the anterior series, and nine large and fifteen small the posterior series. The specimen measures 41 mm. in length, 40 mm. in height, and 46 mm. in depth.

Anadara nugax sp. nov. (Plate III, figs. 10, 10*a*.)

Many valves of what is obviously a common shell were found on the Townsville beach, and were most like the figure of *Arca compacta* Reeve ('Conch. Icon.' II, pl. v, sp. 27, February, 1844; locality unknown), but have more ribs.

Shell small, thick, compact, subangulate posteriorly, rather abruptly truncate anteriorly, posterior area flattened, periostracum dense, brown, shell white, inequilateral. The ribs number thirty-five, narrow, flattened, interstices striate, narrower than ribs which are faintly subnodulose. The ligamental narrow area is chevron-marked as usual. Hinge line, teeth numerous, crowded, nineteen anteriorly, forty-two posteriorly, the anterior series definitely on a lower plane.

Specimens reach 35 mm. in length, but the shell figured measures 25 mm. in length, 19 mm. in height, and 7 mm. in depth, single valve.

Anadara jurata sp. nov. (Plate III, figs. 11, 11*a*.)

Another common shell on the Townsville beach, as valves, is nearest *Arca gubernaculum* Reeve (' Conch. Icon.' II, pl. iii, sp. and fig. 14, February, 1844) from Samar Island, Philippines. In Reeve's shell there are thirty-two to thirty-three ribs while the Queensland shell has only twenty-eight ribs. In the latter the hinge line is straight, slightly curved at ends, anteriorly with twenty-two teeth, posteriorly with twenty-eight laterally sloping. The number of teeth varies with growth, so that in a larger specimen agreeing in size with Reeve's figure there are thirty-one teeth anteriorly, the teeth vertical, close together, towards the centre very closely packed; the posterior series numbers forty, not so closely packed medially and separating and slanting laterally. The ribs are flat and smooth with only a vestige of sculpture anteriorly, where thread lines transversely cross the intervals between the ribs and slightly override the ribs themselves for less than a dozen ribs. The Philippine Island shell is described as having the ribs " flat, slightly nodulosely serrated ".

The shell figured measures 33 mm. in length, 22 mm. in height, and 9 mm. in depth, single valve.

[*Arca chalcanthum* Reeve.

Shirley added to the Queensland List *Arca chalcanthum* Reeve (' Conch. Icon.' II, pl. vii, sp. 43, February, 1844 ; Zebu Island, Philippines) from Normanton. This locality is inland from the Gulf of Carpentaria, and the shells recorded by Shirley from there include extralimital species, indicating that the collection named by him was merely a lot of shells of unknown localities, and hence this introduction is probably based on a foreign shell. Reeve's figure suggests the shell I have called *nugax*, and contrasted with *compacta*, but the Queensland shell has no nodulous ribs ; apparently it has little to do with *gubernaculum* Reeve, with which Lamy associated it with varietal rank. Lamy also added *luzonica* Reeve as a variety, though Reeve had determined it as equivalve, and *gubernaculum* and *chalcanthum* as inequivalve.]

Anadara addita sp. nov.

At Seaforth a valve was picked up which did not fit into any of the twenty odd species otherwise there collected.

It was rather small, 30 mm. × 25 × 11 mm., and obviously young. It was not so solid as the rest of this genus and was elongate oval anteriorly rounded, the ventral line rounded and the posterior end a little broadened and subangulate ; rather compressed ventrally, the umbones approximated, the ligamental area very narrow, the shell swollen towards the posterior keel ; the ribs are narrow, deeply cut, the interstices broader than the ribs, which number twenty-eight, the anterior seven nodulose, the nodules distant, the succeeding two or three showing obsoletely nodulose, but the rest smoothish ; the interstices almost smooth anteriorly, obscurely transversely grooved marginad.

Hinge line showing a medial diagonal break, the anterior teeth sixteen in number, vertical, long, crowded, the outer four a little separate and stouter ; the posterior series eighteen of similar design but not so closely set. It cannot be easily compared with any

other local form on account of its compression, rounded ventral edge, and the narrow but distant few ribs and thin shell.

Mr. A. E. J. Thackway collected at Caloundra a very similar but larger valve measuring 44 mm. × 35 mm. × 15 mm., the sculpture being the same, the ribs the same number, the interstitial engraving a little more pronounced, the hinge teeth more numerous, twenty and twenty-eight, the cross tooth more noticeable.

Reeve has included a small shell as *Arca myristica* (' Conch. Icon.' II, pl. vii, sp. 42, February, 1844) from the Island of Negros, Philippines, whose superficies recall this species, but which has twenty-three or twenty-four ribs only.

Genus *Tegillarca* nov.

Type : *T.* (*granosa*) *bessalis* nov.

1853. *Anomalocardia* Morch, Cat. Conch. Yoldi, fasc. II, p. 41, April.
Haplotype : *Arca granosa* Linné.

Not *Anomalocardia* Schumacher, 1817.

This group is characterized by the sculpture, form, teeth and ligamental covering.

The shell is somewhat regularly elongate-oval, the valves swollen, the sculpture of a few rugose ribs rather narrow, the intervals as wide or wider, the ribs fading posteriorly ; the ligamental area is fairly broad, and the covering does not entirely fill the area but leaves a naked space on each side anteriorly.

The hinge-line is straight, teeth vertical, very little slanting at either end, the series separated and in the central space a rather large tooth, in a medium sized shell showing twenty-two teeth in the anterior series and twenty-eight posteriorly.

Tegillarca (*granosa*) *bessalis* sp. nov.

In Hedley's Queensland List was included *Arca granosa* Linné, and specimens so named are in this Museum from Albany Passage, 4–14 fathoms, Torres Straits. The exact delimitation of Linné's *Arca granosa* (' Syst. Nat.', 10th ed., p. 694, 1758) is difficult, as Linné gave four references, and, as locality, " O. Europae meridionalis ", which, of course, is quite incorrect. The form of the group is well marked and as representative of the Linnean species Reeve's determination (' Conch. Icon.', II, pl. iii, sp. 15*a*, January, 1844) of a Philippine Island shell has been accepted.

The Torres Straits shells differ from Philippine Island specimens in being smaller, shallower, and with the sculpture less nodulose.

Shell small, with a rounded ventral margin, posterior area not angulately separated, and anterior margin rounded. Ribs number eighteen with wider interspaces which are finely striate ; the ribs are squarely cut and bear angulate nodules somewhat distantly placed, the posterior ribs not nodulose. Ligamental area narrow, chevron-marked, hinge line short, teeth small, crowded, vertical, about twenty in the anterior series, thirty in the posterior. Length, 38 mm. ; height, 30 mm. ; depth, 13·5 mm., single valve.

West Australian shells, which have been called *granosa*, *e. g.* by Odhner, differ in their more square shape and appear to be better associated with " *rhombea* " than with *granosa*. Reeve figured *rhombea* (' Conch. Icon.' II, pl. ii, fig. 12, December, 1843) from the Chinese Seas and Ceylon, a squarely heart-shaped shell, umbones remote, angulate

posteriorly, the number of ribs not being given, but under *granosa* Reeve states that *rhombea* has twenty-six ribs.

Reeve also described *cuneata* ('Conch. Icon.' II, pl. vi, sp. and fig. 37, February, 1844) from Zanzibar, noting "area of the ligament very wide, bent inwards: umbones small, distant". . . . "the great width of the ligamentary area, separating the umbones asunder to a considerable extent, imparts a wedge-like form to this shell, by which it may be easily recognized." The name "*cuneata*" has been given in this Museum to a series from Karumba, Gulf of Carpentaria, but it is not at all applicable, the shells being rather small, equivalve, fairly regular elongate oval, semi-keeled posteriorly, ribbed rather distantly, both valves much alike, ribs twenty to twenty-two, elevated, distantly nodose, interstices deep, scarcely transversely striate, remains of a short periostracum present; hinge teeth many, separable into two series, anterior twenty, posterior twenty-seven, the teeth straight, vertical, hinge line straight, ligamental area almost covered, an anterior strip, however, naked.

Mr. Melbourne Ward collected a series of valves on the beach at Aroma, South-east Papua, which vary in length from under 30 mm. to 55 mm., but one reaches 76 mm. in length, recalling Reeve's figure 15*b*, but is differently shaped.

Genus *Scapharca*.

1847. *Scapharca* (written *Scapharea*) Gray, Proc. Zool. Soc. (Lond.) p. 198, November, 1847.
Orthotype: *Arca inaequivalvis* Bruguière.

Shell large, thin, subglobose, inequivalve. This group seems to be a recent derivative of *Anadara* but is very easily recognizable.

The original description and figure of Chemnitz ('Syst. Conch. Cab.' (Martini), VII, p. 210, pl. lvi, fig. 552, 1784), the basis of Bruguière's species, of a shell from Tranquebar on the Coromandel Coast shows a rather rounded shell, more like *disparilis* Reeve ('Conch. Icon.' II, pl. ix, sp. 59, March, 1844; no locality) than Reeve's elongate idea of *inequivalvis* ('Conch. Icon.' II, pl. viii, sp. 54, February, 1844).

Scapharca aliena sp. nov. (Plate III, figs. 15, 15*a*.)

Hedley included in his Queensland List *A. disparilis* Reeve, but Smith ('Proc. Zool. Soc. (Lond.)', p. 431, 1891) had determined that *rufescens* Reeve was the same and had priority, both having been published in the 'Conch. Icon.' II, the latter on pl. viii, sp. 53, the former, pl. ix, sp. 59, the eighth plate appearing a month earlier, February and March, 1844. Schmeltz ('Cat. Godeffroy Mus.' IV, p. 114, May, 1869) had recorded *Scapharca cepoides* Reeve, from Rockhampton, although that species had been described (pl. x, fig. 66) from San Miguel, South America, but the present species was intended.

Lamy included *disparilis* and *rufescens* as distinct species, citing as a synonym of the former *hispida* Philippi, and as a variety of the latter, *penangana* Jousseaume. Philippi's *Arca hispida* ('Abbild. Conch.' III, p. 86, *Arca*, pl. v, fig. 4, October, 1849) was described from Mergui, as a small shell, 16 lines long, 12½ lines high and 11 lines deep, with thirty-eight ribs, and apparently belongs to this series, coming close geographically to *inaequivalvis*. It may be noted that Lamy became confused in connection with the citation of

Chemnitz's fig. 552, as he first quoted it as displaying *disparilis* Reeve = *hispida* Philippi, and then ruled out *A. inaequivalvis* Bruguière as being based on a mediocre figure of Chemnitz and insufficient for exact determination. On the latter account he accepted Reeve's interpretation of *A. inaequivalvis* instead—a very faulty conclusion.

A fine series of valves with a couple of complete shells was collected at Seaforth, north of Mackay, Queensland, which proves the distinction of the Australian species from any other. In the first place the juvenile is nothing like *rufescens*, and the adult not much like *disparilis*; really the young shell is more like *globosa* Reeve (' Conch. Icon.' II, pl. viii, fig. 52, 1849: Philippine Islands), and this shape persists until maturity in the right valve, the left valve being clasped and the ventral edge consequently less rounded, the posterior angle a little produced. The largest valve (left) shows thirty-six ribs, flattened, smooth, rather narrow, separated by intervals a little more than half the width of the ribs, which have straight edges; the teeth are separated medially into two series and at each end the teeth become separated and confused; in a smaller shell the teeth are quite regular, the interval between the series well marked with a rather prominent tooth; the anterior series numbers twenty, vertical, a little spaced laterally; the posterior series numbers forty, crowded medially, separated a little towards the end but still vertical.

The shell is covered with a thin greenish-brown periostracum, becoming more coarsely laminate towards the ventral edge, and from the interstices of the ribs arise laminar triangular processes.

The shells range in size from 26 mm. in length, 22 mm. in height and 9 mm. in depth of valve, to 76 mm. in length, 68 mm. in height and 33 mm. in depth of valve, a pair measuring 68 mm. in length, 60 mm. in height, and 55 mm. in depth.

Genus *Imparilarca*.

1929. *Imparilarca* Iredale, Mem. Queensland Mus. IX, p. 263, 29th June.
Orthotype: *I. hubbardi* Iredale.

This genus was provided to include the *Anadara*-like Arks with inequivalve shells and discrepant sculpture, which could not be placed under *Scapharca* Gray (written *Scapharea* in error), which is scarcely separable from *Anadara*. These two names were introduced at the same time and the young of *Anadara* are sometimes notably inequivalve. In *Scapharca* the general facies, sculpture and form closely resemble those of *Anadara*, but in *Imparilarca* the shell is much stouter and the sculpture distinct, the form of the valves also differing. The shell is elongately oval, inequilateral, inequivalve, not much anterior narrowing nor posterior widening, but strong angulation of the posterior area. The sculpture consists of elevated narrow ribs with deep intervals almost as broad, the ribs subnodulose, the nodulation marked on the left valve, obscure on the right valve. The ligamental area is very broad, marked as usual, with diagonal grooves radiating from the umbones. The hinge line is long and straight, the teeth small, vertical and numerous, a distinct gap between the anterior and posterior series in which two large, coarse teeth sometimes appear, in a large shell the anterior teeth number twenty-eight, the outer ones a little chevron-shaped, the inner ones vertical and closely packed; the posterior series are not so closely set medially and are shorter, and the outer ones more distant and chevron, all teeth being finely denticulate basally; through being more loosely set there are only thirty-five teeth in the posterior series, though its length is much

more than that of the anterior series ; a juvenile shell has eight anterior teeth and fifteen posterior teeth with a clear space between.

A beautiful little shell dredged at Lindeman Island, measuring 8·5 mm. in length, is slightly oblique, and shows the umbonal depressions and the ligamental covering behind the umbones only very clearly.

Imparilarca hubbardi Iredale, 1929.

1929. *Imparilarca hubbardi* Iredale, Mem. Queensland. Mus. IX, p. 263, pl. xxx, figs. 1, 2, 29th June : Innisfail, North Queensland.

This species, which had been misidentified as *Arca clathrata* Reeve ('Conch. Icon.' II, pl. vii, sp. 48, February, 1844 ; Burias Island, Philippines) and recorded under this name by Hedley (p. 344), ranges along the mainland of Queensland. This error was probably due to Smith.

Genus *Potiarca* nov.

Type : *P.* (*pilula*) *saccula* nov.

The group of " Arcas " surrounding *pilula* Reeve is instantly separated from other *Anadara*-like shells by the subglobose form, the discrepant valve-sculpture, the entirely covered ligamental area lacking chevron grooving, and essentially by the strongly incurved umbones, which do not show any median depression.

This last feature must be emphasized, as otherwise it is seen through such diverse groupings as *Cucullaea*, *Trisidos*, *Arca*, *Anadara*, etc.

In form the shells are all subglobose, the height, width and depth being subequal, the umbones so strongly incurved that even in the smallest specimens the umbo itself cannot be examined. There is a thick periostracum with a dense interstitial fringe growth. Though the valves are a little oblique the umbones are almost central, thus suggesting an equilateral form while the inequivalve nature of the immature becomes somewhat obsolete in the adult. The muscle scars are strongly marked and show their growth markedly, so that the anterior is lengthened and indicated by flange impressions on each side, while the posterior is less marked and there is large retractor muscle scar above.

Prashad (p. 40) wrote, " I cannot agree with Lamy that *A. pilula* Reeve is a member of the subgenus *Cunearca* Dall, and in spite of its slightly inequivalve shell I believe that it is a true *Anadara* ". This indicates the imperfect appreciation of these shells, as the " true *Anadara* " is slightly inequivalve in the immature.

Potiarca (*pilula*) *saccula* subsp. nov. (Plate III, figs. 17, 17*a*.)

1843. *Arca pilula* Reeve, Conch. Icon. II, pl. ii, sp. and fig. 8, December : Burias Island, Philippines.

All along the Queensland coast this kind of shell is abundant and many specimens from Townsville measured up to 28 mm. in length, 28 mm. in height and 28 mm. in depth. Shells from Port Curtis, south of Townsville, range up to 35 mm. in length by 37 mm. in height, and others from Cooktown, north of Townsville, reach the same size.

The typical form measured 33 mm. in length by 31 mm. in height, but Morlet (' Journ. de Conch.' XXXVII, p. 189, pl. viii, fig. 6, 1st April, 1889) introduced *Arca* (*Anadara*)

sabinae for a smaller *pilula*-like species measuring 13 mm. in length, 12·5 mm. in height and 11·5 mm. in depth. Crosse and Fischer (*loc. cit.*, p. 292, October, 1889) admitted Morlet's species from French Cochin-China as common but larger, 20 mm. in length and with twenty-five to twenty-seven ribs.

Lynge (pp. 125–29) included the species from the Gulf of Siam (the type locality) as from 9–17 mm., while Lamy ('Journ. de Conch.' LV, p. 276, 1907) did not reject it, though noting the slight distinction from *pilula*.

The large size of the Queensland shells therefore merits separation, especially as our shell becomes higher than long and thus is of different form; the left valve is finely nodulous and clasps the right, whose anterior ribs only are nodulous; the vertical teeth number eighteen on each side with a median tooth. In the juvenile the teeth are massed together in a shallow curve with a median hiatus, somewhat recalling the hinge of "*Limopsis*", but in the adult the teeth are still numerous but less arched and more spaced.

Genus *Gabinarca* nov.

Type: *G. pellita* sp. nov.

Shell very small, stout, obese, sculpture reticulate, ligamental covering medial, small diamond-shaped, equivalve, inequilateral, byssal opening very small, byssus thin.

The small shells with a small diamond ligamental covering are in a very perplexing state. Bernard has given figures of the development of the hinge of "*Arca*", and it is obvious these represent that early stage and consequently this feature cannot be used as a generic character, probably being of family value.

The earliest name applied to any small shell with a diamond ligament appears to have been *Striarca* Conrad, and this was early used for the *lactea* group. It was discarded by Cossmann ('Ann. Soc. Roy. Malac. Belg.' XXII, 1887, p. 138, 1888), who proposed *Fossularca*, naming the fossil *Arca quadrilatera* Lamarck. In 1913, however, Cossmann and Peyrot ('Actes Soc. Linn. Bord. LXVI, p. 192, 1st July, 1913) separated the form of *lactea* Linné under the name *Galactella*. Some years previously Melvill and Standen ('Journ. Linn. Soc. (Lond.), Zool.' XXVII, p. 185, 1899) had used *Venusta* subgenerically for *lactea*, without any indication of novelty, but that name had been previously used by Böttger in 1887. Thiele (p. 793) has used *Arcopsis* Koenen, 1885 to replace *Fossularca*.

The species with the diamond ligamental covering are definitely not congeneric, as in the Queensland list alone we have half-a-dozen different styles of shells showing this, and in *Navicula* we see the development from a small fossette to a completely covered ligamental area.

Gabinarca pellita sp. nov. (Plate III, figs. 18, 18*a*.)

Shell small, squarely ovate, swollen, obese (almost as gibbous as in Reeve's fig. 106 of *Arca solida*), umbones incurved, distant, posterior angle marked, almost acute, posterior section steep. The form can be gauged from the measurements—length 15 mm., height 10 mm., depth 11·5 mm. The shell lives under stones all along the coast of Queensland between tide-marks. The sculpture consists of radial ribs, the anterior ones being fine with smaller ones intervening and non-nodulose; the posterior ones are rather distant and strong, but only weakly nodulose, while on the median area the anterior ones are

plain, but the posterior ones are completely beaded and regular, a short periostracum covering the shell originally, but wearing off the umbonal area. The hinge is straight, a little curved at the ends where the teeth are larger, seven at the anterior end, ten at the posterior end, all very finely denticulate laterally; medially there are about thirteen smaller vertical teeth. Internally there is a very slight striation inside the pallial line and the muscle scars are large, not bounded by flanges.

This is the species previously called *Arca afra* by Hedley, while Melvill and Standen recorded *A. zebuensis*, *Barbatia lactea* and *B. sculptilis*. Lamy lumped so many forms under the name *afra* that even Lynge (p. 115) could not accept them, using *sculptilis* Reeve for his Gulf of Siam shells, adding, "*A. zebuensis* Reeve is undoubtedly synonymous with *A. sculptilis*". What Melvill and Standen intended by *lactea* Linné is beyond conjecture, and Lynge (p. 115), in connection with *Arca* (*Fossularca*) *pectunculiformis* Dunker, commented "*Arca olivacea*, Reeve, is very closely related to this species. Can some of the recorded occurrences of *A. lactea* L. in Asiatic and Australian waters be due to the erroneous determination of *A. pectunculiformis* Dunker ?" The present species is nothing much like either *lactea* or *pectunculiformis*. Lamy ('Journ. de Conch.' LII, p. 147, pl. v, figs. 6, 7, 17th September, 1904) has discussed and figured *Arca pisolina* Lamarck ('Hist. Anim. s. Vert.' VI, pt. 1, p. 41, July, 1819) described from the seas of New Holland. Lamy apparently places it near *sculptilis*, but the figure does not suit any species now available so it must be left until West Australian shells are studied, as if it came from Australia at all it would be from that locality.

Gabinarca protrita sp. nov. (Plate III, figs. 19, 19*a*.)

Shells have been commonly found in Queensland dredgings which are very like the preceding littoral species, but are never as large, always more regular, less swollen with more even sculpture and are therefore here described, the type being a Low Isles shell.

Shell small, inequilateral, equivalve, elongate oval, a little swollen; posterior angulation marked, but posterior side sloping not steeply. The ventral margin is nearly straight, the ventral sinuation very slight, the anterior end rounded, the posterior end sharply angulate. The sculpture consists of very close-set ribbing with indistinct nodulation throughout, a little more marked on the posterior portion. The hinge line is straight, the teeth being fairly even, a few median ones being very small, about seven in number, the anterior ones being ten, the posterior ones about twenty. The muscle scars are bounded in some examples exactly as in *Spinearca*, suggesting development of the latter from this source, but at the present time these are found living together.

The measurements read : length, 10 mm. ; height, 6·5 mm. ; depth, 4 mm.

Smith ('Rep. Zool. Coll. "Alert"', p. 111, 1884) recorded *Arca* (*Barbatia*) *symmetrica* Reeve, from Port Molle, Queensland, 12–20 fathoms, which possibly refers to this species.

Genus *Spinearca* nov.

Type: *S. deliciosa* sp. nov.

Shell small, thin, translucent, shortly elongate oval, swollen, angulation posteriorly marked, sculpture of prickly ribs, interstices striate, umbones incurved, ligamental area of medium width, even, a small diamond covering medially only. The sculpture is peculiar, being radial ribs, the ribs bearing close-set prickles, the interstices regularly striate ; this

sculpture is seen on the umbones so that it is an essential feature. The hinge line is nearly straight, the teeth small, separated into three series, eight to ten anteriorly sloping a little, eight small vertical teeth below the diamond, and ten to twelve small posterior teeth not much sloping.

The margin is denticulate through the prickly ribs, both ends being rounded, the ventral margin straight. The interior inside the pallial line is weakly striate, while the muscle scars are bounded by ridges on each side extending into the umbonal cavity.

Spinearca deliciosa sp. nov. (Plate III, figs. 20, 20*a*.)

This species was dredged at Station V in 37 fathoms, and apparently closely resembles superficially *Arca* (*Anadara*) *mortenseni* Lynge (p. 120, pl. ii, figs. 1, 2), described from the Gulf of Siam in 35 fathoms. This was based on a single valve and was placed under *Anadara*, and our shells differ generically, and are not as deep, have more ribs and more hinge teeth although they are smaller.

The type measures 10 mm. in length, 8 mm. in height and 3·5 mm. in depth (single valve), and has about thirty-five primary ribs, others intercalating towards the margin.

Genus *Mulinarca* nov.

Type: *Barbatia aceraea* Melvill and Standen.

As the distinguishing features of the Arks were not then known, Melvill and Standen placed the type-species in the *Acar* section of *Barbatia*. Its general shape may have influenced them as it has a vague resemblance to some Barbatioid shells, and it is small, like *Acar*. There is a narrow ligamental area which shows a small median diamond, effectually removing it from the neighbourhood of *Barbatia* and *Acar* and bringing it close to the *Gabinarca* group, *i. e. Fossularca* olim. In shape it is elongate oval, swollen, not very deep, anterior end rounded, posterior extremity angulate, ventral margin straight, sinuate medially. The ligamental area is narrow, the umbones incurved, the small diamond below being the only covering on the area. The hinge line can be separated into three sections, seven larger teeth anteriorly, a little distant and sloping, while posteriorly there are fourteen similar teeth; medially below the diamond there are nine small vertical teeth. Internally there is no striation, and the muscle-scars show no ridges in the adult, but slight ridges can be seen in the juvenile state.

Mulinarca aceraea Melvill and Standen, 1899. (Plate III, figs. 21, 21*a*.)

1899. *Barbatia* (*Acar*) *aceraea* Melvill and Standen, Journ. Linn. Soc. (Lond.), Zool. XXVII, p. 186, pl. x, fig. 15: Torres Straits.

Although superficially the figure given by Melvill and Standen is poor, it is good enough for recognition when the right shell is in hand. It is not, however, a *Barbatia*, nor an *Acar*, as shown above.

The shell figured, from Low Isles, measures 13 mm. in length, 8 mm. in height, and 4·5 mm. in depth, single valves. It is elongately oval and swollen, medially a deep depression, which causes the ventral margin's sinuation; the posterior angle is strong, though not acute, and the posterior portion is steep. The sculpture consists of fine radial ribs, subnodulose through growth-lines only, the ribs alternating, finer, developing strength with age.

Genus *Estellacar* nov.

Type: *E. saga* sp. nov.

Shell of medium size, equilateral, equivalve, elongate oval, thin, compressed; anterior and posterior portions about equal in size, with similar rounded angulation, separating them from the more elevated median portion, hinge line comparatively short, teeth small and weak, ligamental area narrow, covered with vertical lines, muscle-scars large, interior striated, sculpture of very fine radials covered by a thin, dark-coloured periostracum. This curious Ark recalls Reeve's *Arca olivacea* from the description and figure, and has been so determined in this Museum. It is, however, very much larger, and Lamy does not add much to Reeve's description, and our shell could not be associated with *lactea* under any conditions.

Estellacar saga sp. nov. (Plate III, figs. 22, 22*a*.)

The general features already given are here supplemented. A juvenile shell measuring 18 mm. in length, 10·5 mm. in height and 4 mm. in depth, single valve, as almost exactly equilateral, each end being evenly rounded, and the ventral margin straight, the whole shell flattened, and the angulation of the anterior and posterior sides rounded and flattened. The hinge line measures about 9 mm., with about fifteen or sixteen teeth on each side, the posterior series a little larger. The exterior sculpture is very fine, growth-lines marked and causing a little reticulation marginad ; the interior faintly striate inside the pallial line. The largest specimen measures 39 mm. in length, 23 mm. in height, and 10 mm. in depth, single valve ; this is a little oblique towards the posterior end, and the sculpture is coarser, but still very fine ; the teeth are a little stronger but still weak, and only number about twenty-one on each side with one median small tooth between the two series, the majority of the teeth being vertical and the ones at the extremity not much larger. The type locality is Port Curtis.

Genus *Verilarca* nov.

Type: *V. bivia* nov.

This name is introduced for a shell with a superficial resemblance to *Gabinarca*, but the shell is compressed, the sculpture plain radials, and the ligament is narrow with a broad triangular medial covering showing perpendicular grooves. The hinge is more curved and recalls that of *Didimacar*, from which the ligamental covering immediately separates it. Shell small, compressed, almost equilateral, posterior side a little produced; coloration probably white, periostracum missing. Hinge with fifteen teeth on posterior side, arched, fifth from the outside longest and decreasing towards edge and also towards the middle ; about seventeen similar teeth, the seven or eight outside larger than the inner ones, similarly curved, provide the anterior series.

Muscle scars large, distinctly bounded by flanges, that of the posterior more pronounced than that of the anterior. The muscle-scar flanges are the most distinct in the group and are much more pronounced than in *Didimacar*, which appears to represent *pectunculiformis* Dunker, and which Stewart regarded as showing flanged muscle scars, placing it under *Halonanus* with doubt, allying it to *Noetia*. The ligamental covering separates this genus very widely from *Noetia*, *Halonanus* and *Didimacar* as described above.

Verilarca bivia sp. nov. (Plate III, figs. 23, 23*a*.)

Shell small, almost equilateral; umbones nearly median, equivalve, coloration white, suboval, compressed. The sculpture consists of distinct flattened ribs with the interstices non-striate, only faint growth-lines being observed. These radials are more closely set both anteriorly and posteriorly, and number between sixty and seventy, about fifteen on the anterior sector, about thirty on the median portion to the rounded posterior angle, and then about twenty crowded on the short posterior side, where they are also inclined to show a faint nodulation through growth-lines. The anterior edge is rounded, and the ventral margin is also slightly curved, while the posterior margin is a little rounded also. There is no byssal sinuation showing, while the interior inside the pallial line is clearly striate, the striae rather elevated. The muscle scars are large and rather notably flanged, but the ligamental covering is medial and broadly diamond shape, the ligamental area narrow, but the umbones distant.

The figured specimen was dredged at Low Isles and measures 13·5 mm. in length, 10·5 mm. in height and 3·5 mm. in depth (single valve).

Genus *Didimacar* nov.

Type: *D. repenta* sp. nov.

Living along with the *Gabinarca* series under stones in North Queensland is a shell that differs in shape, but the notable distinction is in the ligamental covering, which is not diamond shape, but extends behind the umbones as in *Acar*. The area is very narrow, the umbones being incurved and almost touching, without any anterior widening, while the teeth form a shallow curve.

This species recalls *Barbatia pectunculiformis* Dunker (' Nov. Conch. Moll. Mar.', p. 88, pl. xxviii, figs. 4–6, 1866: Borneo) only in a vague sense, as Dunker's species is more orbicular, with a short hinge-line and a longer ventral size.

Stewart (p. 78) introduced *Halonanus* from the Eocene of Texas, observing, "I have not noticed *Halonanus* later than the Eocene, and apparently the only living species which may be related to it is '*Barbatia pectunculiformis*'," and added, "It seems that *Noetia* is more closely related to *Cucullaea* and *Glycymeris* than to the *Arcidae*".

Thiele (p. 793) has regarded *Noetia* as a subgenus of *Arca*, and introduced a Section, *Noetiella*, for Dunker's species. Reeve described *Arca tenebrica* (' Conch. Icon.' II, pl. xvi, sp. 105, May, 1844) from the Philippine Islands, noting that "the umbones in this species are very anteriorly situated". This characterizes this group among these small Arks.

Didimacar repenta sp. nov. (Plate III, figs. 24, 24*a*.)

Shell small, elongately oval, rather compressed; beaks almost touching, placed more forward than in any other small Ark of this series, consequently shell inequilateral, equivalve, showing no byssal sinus, though a small thin byssus is present. A thin dark, almost black periostracum covers the whitish shell. The sculpture consists of numerous sharp, radial riblets with smaller ones intercalating; there is a fine, almost obsolete, concentric striation between the ribs, which does not cut them, so that there is no reticulation.

Through the approximation of the umbones the ligamental area is very narrow and

extends from the beaks backwards, being vertically striate ; in front of the beaks the area is a little broader and naked. The anterior margin is rounded, the ventral almost straight, with a slight byssal sinuation anteriorly, the posterior margin angulate to the ventral margin, but medially rounded ; posterior angle rounded. The hinge line is a little curved, the larger teeth at each end definitely descending, but the larger portion straight ; the teeth are peculiar, six or seven large anterior ones being followed by fifteen to eighteen small vertical crowded ones under the umbones, then about a dozen thicker and more separated succeeded by the six or seven larger posterior ones. Interiorly the shell is bluish, striate within the pallial line, muscle scars large and differentiated, but no flange could be recorded.

The figured specimen was collected north of Cooktown, North Queensland, and measures 16 mm. in length, 11 mm. in height and 8 mm. in depth.

This species occurs under stones along the coast of Queensland, and, when living in association with *Gabinarca*, is often confused. Smith ('Rep. Zool. Coll. "Alert"', p. 110, 1884) recorded *Arca* (*Barbatia*) *tenebrica* Reeve, from Port Essington and Port Curtis, stating that the surface was "minutely reticulated", but Reeve ('Conch. Icon.' II, pl. xvi, sp. 105, May, 1844) did not give this feature in his Philippine Island shells. As one consequence, Lamy ('Journ. de Conch.' LV, p. 106, pl. i, figs. 7–10, 1907) has described *Arca nigra*, also from the Philippines, as a shell without reticulate sculpture, and Shirley added *nigra* Lamy to the Queensland List, by means of specimens from Moreton Bay, sent to Lamy and identified by him. Lamy states that there are two very similar species differing in their sculpture, but otherwise agreeing, and notes that although he placed them under the subgenus *Fossularca* the ligamental covering was very unlike. The difference is probably really of family value, but the species is allowed here on account of the confusion.

Genus *Barbatiella*.

1917. *Barbatiella* Lamy, Bull. Mus. d'Hist. Nat. Paris, XXXIII, p. 111, *ex* Jousseaume MS.
Tautotype : *B. barbatiella* Lamy, *ex* Jousseaume MS. = *Arca lateralis* Reeve, *fide* Lamy.
1934. *Paranoetia* Thiele, Handb. syst. Weicht. 3rd teil, p. 793.
Haplotype : *Arca lateralis* Reeve.

Lamy published Jousseaume's name while determining the species so named as *Arca lateralis* Reeve. It is a pity that this happened as *lateralis* Reeve is a rather obscure little species, and its peculiar facies may be accompanied by special distinctive internal features. Thiele's section *Paranoetia* of the subgenus *Noetia* was apparently based on the superficial form only. Lamy regarded *lateralis* as the immature form of *venusta*, and from the characters of the latter species placed it under *Noetia*.

The shell is very oblique and thin, with the hinge teeth recalling those of "*Barbatia*", but the cardinal area is strongly vertically ridged, quite unlike the chevron angulate lines of that genus. The muscle scars are, however, of the style of "*Anadara*", or even more like those of *Fossularca*.

Barbatiella venustopsis sp. nov. (Plate IV, figs. 1, 1*a*.)

Hedley included in the Queensland List *Arca venusta* Dunker ('Novit. Conch.' p. 91, pl. xxxi, fig. 1, 1867, *ex* 'Zeitschr. für Malak.' 1852, p. 59 : no locality), but the specimens so named from Mapoon and Karumba are different at all stages, the anterior end more

produced and deeper, more delicate sculpture, and the different teeth separate it from Dunker's figure. Dunker's name cannot be used in any case, as it is pre-occupied by Nyst ('Mem. Ac. Roy. Belg.' XXII, p. 76, 1848), and Lamy sank it as a synonym of *lateralis* Reeve ('Conch. Icon.' II, pl. xvii, sp. 115, June, 1844 : Philippine Islands), but the Queensland shell is less like this, being comparatively longer, and narrower posteriorly and wider anteriorly, but this may be related.

The sculpture is peculiar, the numerous ribs being rounded, with a minor riblet between each, both being originally beaded and still showing a little crenulate effect; these ribs flatten out on the posterior area and other smaller similar ribs intercalate; between thirty-five and forty major ribs can be counted with the same number of minor ribs. The hinge area is so narrow that the umbones are worn away through meeting each other. About nine large posterior and five large anterior teeth persist, the median ones being crushed by the ligament. The type measures 32 mm. in height and 22 mm. in depth.

Genus *Navicula*.

1825. *Navicula* Blainville, Dict. Sci. Nat. (Levrault), XXXIV, p. 319, June 18.
Haplotype : "Arche de Noe" = *Arca noae* Linné.
1833. *Byssoarca* Swainson, Zool. Illus. ser. 2, III, pl. 118, March ; Proc. Zool. Soc. (Lond.), p. 16, 17th May, 1833.
Haplotype : *Byssoarca zebra* Swainson.
1847. *Arca* Gray, Proc. Zool. Soc. (Lond.) p. 197, November, 1847.
Orthotype : *Arca noae* Linné.
1853. *Cibota* Mörch, Cat. Conch. Yoldi, pt. II, p. 39, April, *ex* Browne, *pre* Linnean, new name for *Navicula* Blv. *Daphne* Poli.
Haplotype : *Arca noae* Linné.
[1791. *Daphne* Poli, Test. Sicil. I, Introd. p. 33.
1795. *Daphnoderma* Poli, Test. Sicil. II, pp. 255 and 260.
Not *Daphne* Müller, Zool. Dan. Prodr. pp. xxvii, 199, 1776. Poli's names are not here accepted, but *Daphnoderma* will cause trouble for Polian enthusiasts. Mörch used it for a group not available.]

This style of Ark was long regarded as the typical Ark, as it is based on "Noah's Ark", the best known Ark.

The long boat shape with the broad ligamental area, the straight hinge line with the very numerous almost vertical teeth, distinguish these Arks, so that probably family value will be later granted. It must be remembered that Bernard has given the development of the ligament of an Ark, and it seems to be applicable to this, but apparently not to the "Barbatioid" series. In this series the ligamental covering begins as a small diamond under the umbones, and extends over the whole area, in many cases remaining as a diamond. The number of species to be admitted in this genus is very problematical at present, as the lumping of many distinct forms has thrown the group into great confusion.

Navicula subnavicularis sp. nov. (Plate IV, figs. 2, 2*a*.)

Many series are now available for the discrimination of the Queensland shell hitherto known as *navicularis*. Specimens from Port Curtis, 7–12 fathoms, show the ligamental covering beginning as a small diamond below the umbones, and increasing with age until in senile shells it almost covers the entire area. Juvenile shells have a long posterior beak, which becomes comparatively shortened through the growth of the shell until the

posterior end is almost square, but still sinuate. The hinge teeth are vertical and very numerous ; in the juvenile stage as many as twenty anteriorly and forty-five posteriorly, with a notable median tooth ; the posterior series increases numerically more rapidly than the anterior, so that in an old shell there may be only twenty-seven anterior teeth, one median, and seventy-nine posteriorly. Smith recorded these shells as *navicularis* in the " Alert " Report, citing as synonyms *linter* Philippi, *subquadrangula* Philippi, and the MS. *cumingii* Dunker. Philippi (' Abbild. Conch.' II, *Arca*, pl. iii, March, 1847) gave three figures; first *linter*, an elongate shell with the posterior end angulate, the sculpture of distant beaded ribs, the beaks fairly close together and the ligamental covering a median elongate diamond, less than half the length of the area, the locality being given as Indian Ocean. The second figure showed *navicularis* from Amboina, similarly shaped, but much more swollen, the beaks very low and distant, the sculpture less beaded and the ribs closer, the ligamental area showing a large diamond extending towards the posterior end and covering more than half the area. The third figure was of *subquadrangula* Philippi, also as from Amboina, which presented a weaker sculpture, the posterior end somewhat abruptly truncate, the beaks elevated and a little incurved but distant, the ligamental area covered and showing two diamond lines touching each other. As noted above, the characters of the Queensland shell do not agree with any of these, but Lynge (p. 109), recording *navicularis* as very common, wrote: "In all the specimens from the Gulf of Siam the ligament upon the area has the form figured by Philippi (*loc. cit.*) in Pl. iii, fig. 1," *i. e.* an elongate diamond.

A large number of dead valves dredged at Lindeman Island shows that the ligamental covering is very delicate and easily rubbed off, as it is missing from most of the specimens. Also that the sculpture begins fairly regularly, the median ribs not thickening as much as the external ones, the discrepancy becoming more marked as the shells grow larger.

Shells from Lindeman Island vary from 8·5 mm. (and probably less) to 58 mm. (and more) in length, 4 mm. to 29 mm. (correspondingly) in height and 5 mm. to 30 mm. in width, the umbones incurved at about the anterior fourth and the space between the umbones was about one-fifth the length of the ligamental area.

The shell figured from Port Curtis measures 70 mm. in length, 35 mm. in height and 34 mm. in width, the umbones being 14 mm. apart. A larger specimen goes to 90 mm. in length, 45 mm. in height and 45 mm. in width, the umbones being 21 mm. distant. In this the main ribs number about twenty-two, four thick ones anteriorly, seven thin ones medially, five thicker to the posterior angulation, and six less elevated on the posterior sinuated area. Between each of these major ribs half a dozen threads occur, these being strongest on the medial area and almost obsolete anteriorly. The external coloration is pale brownish, internal pure white.

Navicula aladdin sp. nov. (Plate IV, figs. 3, 3*a*.)

So similar are the " Noah's Arks " that there is great confusion in literature regarding the claims to specific rank of many of the named forms. From comparison of Museum specimens, Smith in the " Challenger " Report lumped together species from such diverse localities as Jamaica, Cape of Good Hope, Zanzibar and Timor. Lamy added to this medley the Philippine Islands, when he drew attention to the distinguishing feature between the series " *imbricata* " and " *ventricosa* ". Lamy pointed out that while in the

former the whole area was covered with ligament, in the latter there was only a small diamond-shaped ligament.

Study of Museum specimens would not enlighten anyone as to the habits of these species, so it will be of interest to record that in Queensland there are two large shells superficially recalling each other, but showing the above distinctive features. The one with the diamond ligament is the well-known inhabitant of the Coral Reefs, living in crevices of coral blocks and having a huge byssal gape and a weak periostracum. A much more uncommon shell hiding in crevices and generally much distorted, sometimes elongated and squashed, at others swollen and very shortened, shows the entire ligamental covering, while this is well seen in the mainland representative, which grows to a fairly large size and boasts a very profuse periostracum.

While these are clearly separable in nature it is much more difficult to select suitable nomination, and as there are no local names, it will be best to use a geographical introduction, and thus attempt a meed of accuracy hitherto never approached.

The name for the group with the ligament covering the whole hinge area is given by Lamy as *imbricata* Bruguière, but that species was described from the West Indies; the synonyms given by Lamy, *tetragona* Lam., *umbonata* Lam., *triundulata* Bory St. Vincent and *americana* Orbigny must refer to this form, but *retusa* Lamarck (' Hist. Anim. s. Vert.' VI (1), p. 39, July, 1819 : Timor) would be applicable to an Indian Ocean form. The type has been figured by Lamy (' Journ. de Conch.' LII, p. 136, pl. v, fig. 12, September 17th, 1904), as also (figs. 1 and 2) that of *A. avellana* Lam. (*loc. cit.*, p. 38). The latter was localized as from Ile S. Pierre and S. François, where this style of shell does not live; very probably Shark's Bay, West Australia, was the locality whence Péron's specimens were collected, but there is no certainty at present through the fact that the species have never been critically studied. Sowerby (' Proc. Mal. Soc. (Lond.),' IV, 1901, p. 211, pl. xxii, fig. 14) has described *Arca bicarinata* from Cebu Island, Philippines, and Lynge (p. 110) would identify this with *kraussi* Philippi from Natal, and *imbricata* Brug. var. *arabica* Philippi from the Red Sea, apparently only following Lamy. According to Sherborn there is a prior *Arca bicarinata* Reuss (' Geogn. Skizz. Boehmen ', I, 1844, p. 194), so Sowerby's name does not concern us much. The shell figured from Townsville measures 50 mm. in length, 32 mm. in height, and 32 mm. in depth; is elongate-oval, anteriorly rounded, posteriorly angulate, the ventral margin rounded, sinuate for the byssal opening before the middle, the byssal gape long and narrow; the shell is somewhat obese, strongly angulate posteriorly and is covered with a long, thick, pale straw, flaky periostracum, which is much lengthened on the posterior angle, and flattened on the posterior area. It is worn off with age from the umbones to the margin, the latter always showing some. The ligamental area is entirely covered with a dark brown, almost black skin, showing a few diagonal cracks, but no complete diamond markings. Coloration, outside reddish brown blotched with paler, inside pink to dark red brown posteriorly. Teeth very numerous, the whole extent of the hinge line, vertical, with little variation in size, nearly forty anteriorly and about fifty posteriorly.

Navicula terebra sp. nov. (Plate IV, figs. 4, 4*a*, 4*b*.)

Living in holes in coral, which it fitted tightly and thus apparently excavated, as its posterior area was even with the coral, a shell was found which agreed well with the description and figure of *Arca bicarinata* Sowerby (' Proc. Mal. Soc. (Lond.),' IV, p. 211,

pl. xxii, fig. 14, July, 1901) from the Cebu Island, Philippine Group. The specimens were not quite as broad as Sowerby's species, which measured, "Long. 19, lat. 9, crass 13 mm.", but as Sowerby's name is invalid, as above noted, the local species is here described.

Shell medium, very swollen, anteriorly narrowed, posteriorly expanded, somewhat wedge-shaped obliquely. Coloration pale cream, periostracum pale cream, the flakes being similar to those of *N. aladdin*, and similar lengthening on the posterior angle and flattening on the posterior area. The ligamental area is wide and almost covered with a very fine pale brown skin. The umbones are incurved, anterior and distant. The sculpture is regular radial ribs cut into regular nodules, more pronounced posteriorly; on the posterior area the ribs are stronger and separated, the nodules becoming elevated, the ribs numbering nine only, the posterior side being strongly angulate. The shell figured is from Low Isles, and measures 25 mm. in length, 18 mm. in height, and 16 mm. in depth.

Navicula parventricosa sp. nov. (Plate IV, figs. 5, *5a*, *5b*.)

Living among coral blocks there is a small Ark of this group with the ligamental area covered as in the mainland *ventricosa*, and unlike the large coral living Ark. It is of varied shape, sometimes compressed, sometimes very swollen; in some cases the ends are sharply truncate, in others attenuate, according to the situation. The hinge-line is straight, with very many closely-packed vertical teeth, the anterior series numbering twenty-three, the posterior twenty-five, a little more separated, the outside ones all broken.

Superficially this species recalls the figure of *Arca ocellata* Reeve ('Conch. Icon.' II, pl. xv, sp. 102, May, 1844: Singapore, 7 fathoms), and is probably the species recorded by Melvill and Standen as *Arca volucris* Reeve ('Conch. Icon.' II, pl. xv, sp. 109, May, 1844: Philippine Islands). Lamy has figured ('Journ. de Conch.' LII, p. 136, pl. v, figs. 1, 2, September 17th, 1904) the type of Lamarck's *Arca avellana* ('Hist. Anim. s. Vert.' VI, pt. 1, p. 38, July, 1819), said to have come from the Isles of S. Pierre and S. François, Nuyt's Archipelago, South Australia, where this kind of shell does not live. Probably Shark's Bay, West Australia, may be the correct locality for Lamarck's species.

Navicula ventricosa Lamarck, 1819. (Plate IV, figs. 6, *6a*.)

1819. *Arca ventricosa* Lamarck, Hist. Anim. s. Vert. VI, (i), p. 38, July: Mers de l'Inde; first reference is Rumph. Mus. t. 44, f. L. *i.e.* Amboina.

The large common coral-reef shell living in crevices is thus named, the locality Amboina furnishing specimens apparently conspecific.

The huge byssal opening and curious rough sculpture, shape and large area with small diamond ligament easily serve to distinguish it. The straight hinge line has a small central tooth, with twenty-two anterior teeth and fifty-three posteriorly, the teeth vertical, large and finely denticulate. The specimen figured is a medium shell from Low Isles measuring 47 mm. in length, 27 mm. in height and 25 mm. in breadth, the sculpture being of beaded ribs, the beading most marked on the anterior part of the medial section.

A series, from Michaelmas Cay, varying from 10 mm. to 93 mm. in length, from 6 mm. to 43 mm. in height, and from 6 mm. to 48 mm. in width, indicates little variation

in coloration, sculpture or form. These agree very well with Philippi's figures of *A. ventricosa* ('Abbild. Conch.' II, p. 211, *Arca*, pl. iv, fig. 4, March, 1847) in form, coloration and sculpture.

Genus *Mesocibota* nov.

Type: *M. luana* nov.

The form is that of *Navicula* rather than that of *Arca* (= *Barbatia* olim); the hinge-line is long and straight, like that of *Navicula*, but the teeth are more like those of *Arca* (= *Barbatia* olim); the muscle scars are more those of "*Barbatia*", but not exactly alike, the coloration being white, while all the *Naviculoid* forms are dark (red). The ligamental covering is peculiar in that it is of large extent, but does not reach the posterior nor anterior ends, being an elongated diamond with chevron markings. This separates it entirely from the Barbatioid series and brings it nearer *Navicula*, and the numerous teeth recall the latter. The distant divided rib sculpture is peculiar, so that this species is very distinct from any other Ark in Australia.

Mesocibota luana sp. nov. (Plate IV, figs. 7, 7*a*.)

Hedley ('Proc. Linn. Soc. N.S.W.' XLI, 1916, p. 680, 4th April, 1917) reported *Arca adamsiana* Dunker ('Novit. Conch.' p. 88, pl. xxix, figs. 4, 5, 6, 1866: China Seas) from Port Curtis, Queensland, dredged from 10 fathoms, stating that Lamy had confirmed his identification, and regarded *Arca signata* Dunker ('Novit. Conch.' p. 112, pl. xxxviii, figs. 3, 5, 1868: no locality) as intergrading. Lynge (p. 110, pl. i, figs. 14, 15) has figured *A. signata* from the Gulf of Siam, placing it in *Arca*, *i. e. Navicula*, his specimens measuring up to 23 mm. Our specimens range up to over 50 mm. in length, and the smaller ones of about 23 mm. differ in shape from Lynge's figure. The figure of the Chinese shell is much more regular than any Australian specimen.

The Port Curtis shells above mentioned have the anterior end less truncate, and the ribs number about twenty-four, each being distinctly divided into two, and all are clearly beaded until we reach the end of the posterior area. A thick periostracum covers the living shell, longer and more flaky posteriorly. The hinge teeth are small and numerous, but slope at the ends; the anterior series numbers about twenty; there are about twenty smaller crowded vertical medially and then there are about forty posteriorly.

The Queensland Arks would now read:

Cucullaea labiata petita	Low Isles.
vaga.	
Arca corallicola	Low Isles.
multivillosa.	
antilima	Low Isles.
parvivillosa.	
prolatens.	
Savignyarca scazon.	
benthicola	Low Isles.
Barbatirus mimulus	Low Isles.
terebrans	Low Isles.
Acar dubia	Low Isles.
iota	Low Isles.

Vitracar laterosa	Low Isles.
Mabellarca dautzenbergi	Low Isles.
adjacens	Low Isles.
? disessa.	
? fortunata.	
Miratacar wendti.	
Mimarcaria saviolum.	
Thronacar corpulenta.	
Ustularca cruciata renuta	Low Isles.
Opularca tenella egenora	Low Isles.
Trisidos tortuosa.	
yongei	Low Isles.
semitorta	Low Isles.
Anadara maculosa	Low Isles.
suggesta.	
crebricostata.	
exulta	Low Isles.
trapezia trapezia.	
trapezia posita.	
nicholsoni.	
passa.	
nugax.	
jurata.	
addita.	
Tegillarca (granosa) bessalis.	
Scapharca aliena.	
Imparilarca hubbardi	Low Isles.
Potiarca (pilula) saccula	Low Isles.
Gabinarca pellita.	
protrita	Low Isles.
Spinearca deliciosa	Low Isles.
Mulinarca aceraea	Low Isles.
Estellacar saga.	
Verilarca bivia	Low Isles.
Didimacar repenta.	
Barbatiella venustopsis.	
Navicula subnavicularis.	
aladdin.	
terebra	Low Isles.
parventricosa	Low Isles.
ventricosa	Low Isles.
Mesocibota luana.	

Family GLYCYMERIDAE.

The Globular Arks, as members of this family have been called, are easily recognizable from their almost orbicular form, smooth or radially-ribbed exterior, and their hinge formation.

Commonly all the species have been referred to the one genus, *Glycymeris* (= *Pectunculus* of recent French workers), but probably many genera will later be admitted. Already the Southern Australian species have been split into the genera *Tucetona*, *Veletuceta* and *Grandaxinaea*, while *Melaxinaea* has been introduced for a very curious tropical Queensland form.

Tropical forms may require even more subdivision, as there appear to be distinct groups among the strongly-ribbed species, and even among the smooth species. The shape is so generalized and the teeth and hinge area show little variation that it is difficult at present to understand the relationships of the species. So far the strongly-ribbed species around *amboinensis* Gmelin belong to the reef fauna, while the smooth species are more commonly coastal forms. Some groups have been found both on the reef and on the coast, but as they all live in the sand below low water this is to be expected.

The Queensland species of this family may be allotted to different genera, which may be thus recognized :

Shell small, more or less beaked, sculpture of fine radial threads (comparatively smooth), teeth in a more or less angulate arch . . . *Veletuceta*.
Shell small, generally beaked, sculpture of alternate large beaded ribs and finer smooth ribs, teeth in a shallow arch . . . . . . *Tucetilla*.
Shell large, not beaked, sculpture of broad ribs, teeth in a rounded arch . *Tucetona*.
Shell large, flattened, not beaked, sculpture of many very fine beaded ribs latticed with threads, teeth small, in a very angulate arch . . *Melaxinaea*.

Genus *Veletuceta*.

1931. *Veletuceta* Iredale, Rec. Austr. Mus. XVIII, p. 203, 29th June.
Orthotype : *Glycymeris flammeus* Reeve.

This genus was proposed for the smooth Glycymerids with velvety periostracum, and whose orthotype was listed by Hedley from Queensland under the name *G. australis*. Hedley's compilation of Queensland species reads *capricornea* Hedley, *cardiiformis* Angas, *crebriliratus* Sowerby, *fringilla* Angas, *pectunculus* Linné, *queenslandica* Hedley, *tenuicostatus* Reeve and *vitreus* Lamarck ; *australis* Quoy and Gaimard and *hanleyi* Angas were later added, *cardiiformis* Angas being emended to *hoylei* Melvill and Standen, while *pectunculus* Linné was displaced by *amboinensis* Gmelin. Shirley added, erroneously, *angulatus* Lam. (= *fringilla* Angas *supra*), *australis* var. *grayana* Dunker (= *australis* Q. & G., *supra*), *holoserica* Reeve (= *hedleyi* Lamy), and *striatularis* Lam. (probably meaning *crebriliratus* Sowerby, the Lamarckian species being West and Southern Australian).

The species in the above list referred to *Veletuceta* would be *fringilla* Angas, *queenslandica* Hedley, *australis* Quoy and Gaimard, *hanleyi* Angas ; the species referred to here as *australis* Quoy and Gaimard being named *hedleyi* by Lamy, and is the *holoserica* recorded by Shirley.

The species of *Veletuceta* may be separated by means of the shape, coloration and hinge characters, thus :

Shell with posterior side rounded, white or red, hinge line angulate, teeth closely set, twelve to fourteen on each side . . . . *hedleyi*.

Shell with posterior side rounded, white, hinge line less angulate, teeth further apart, ten on each side . . . . *impasta.*
Shell with posterior side subangulate, curiously particolor, teeth few, far apart, eight on each side, hinge line curved . . . . *cotinga.*
Shell with posterior side subangulate, not particolor, teeth many, closely set, twelve on each side, hinge line curved . . . . *fringilla.*
Shell with posterior side subangulate, not particolor, more strongly sculptured, teeth few, not close together, nine on each side, smaller, hinge line curved . . . . *queenslandica.*

Veletuceta queenslandica Hedley, 1906. (Plate IV, figs. 10, 10*a*.)

1906. *Glycymeris queenslandica* Hedley, Proc. Linn. Soc. N.S.W., XXXI, p. 469, pl. xxxvi, figs. 3, 4, 19th November: Mast Head Reef, 19–20 fathoms, Capricorn Group, South Queensland.

This species represents the beaked series of smooth shells, the mainland northern form being *fringilla*, the Torres Straits shell, *cotinga*, and the New South Wales form, *thackwayi*.

The northern ones are smaller, stouter and with stronger teeth, while the southern ones are larger, thinner, and with weaker teeth.

The shell here figured is much larger than Hedley's type, but is from an adjacent reef, North-West Islet, and measures 30 mm. in length, and 29 mm. in height.

Veletuceta hedleyi Lamy, 1912.

1912. *Pectunculus hedleyi* Lamy, Journ. de Conch. LIX, 1911, p. 123, pl. ii, figs. 6, 7: Bundaberg, Queensland.

The specimen figured by Lamy was of abnormal coloration, and a long series collected at Caloundra shows that it is most commonly white, with the umbones marked with a few yellowish dashes; in a few rare cases the dashes increase and continue all over the shell, thus mimicking the Southern "*flammea*", and accounting for the record of that species and *grayana* from Queensland; a large specimen of this normal form has been cited as *holosericus*, which is its southern representative; it has more tendency to becoming oblique than that species and consequently the whole series shows clear distinction; in some shells the yellow-brown colour masses and extending marginad leaves the anterior half uncoloured, suggesting the Torres Strait particoloured shell hereafter named.

The hinge is typically that of *holosericus*, and the interior is generally white, but sometimes brown patches occur, which coalesce to produce the abnormal typical shell.

The largest specimen measures 36 mm. by 36 mm.

Veletuceta impasta sp. nov. (Plate IV, figs. 8, 8*a*.)

Shell small, inequilateral, equivalve, somewhat compressed; posterior side not angulate, coloration white to cream with creamy darker markings, periostracum dense, short, pale brown. Hinge line arched, teeth not closely set, ten large teeth on each side, ligament intruding and perhaps obliterating three or four more, the ligamental area shallow and long.

The shell figured was dredged by the Expedition in 4 fathoms, quarter of a mile south of Cape Kimberley, a coastal locality, and the species occurs on the northern beaches, *e. g.* Daintree River entrance beach. The type measures 27 mm. in breadth by 25·5 mm. in height.

The species is the northern representative of *hedleyi* Lamy, even as that represents the Sydney *holoserica* Reeve, and these form a series which may later be linked up into one with definite subspecies. The present form is the smallest, and when it agrees in size with southern shells it is more oblique and has a larger ligament showing.

Veletuceta fringilla Angas, 1872.

1872. *Axinaea fringilla* Angas, Proc. Zool. Soc. (Lond.), 1871, p. 612, pl. xlii, fig. 10 : Port Curtis, Queensland.

1913. (*Glycymeris*) *emberiza* Hedley, Proc. Linn. Soc. N.S.W. XXXVIII, p. 265, 5th November : *ex* Angas MS. as synonym.

This species occurs on the mainland beaches northward from Port Curtis, and the Expedition picked out some dead valves from a dredging made in 4 fathoms a quarter of a mile south of Cape Kimberley. Along with undoubted beaked shells were the specimens I have figured under the name *impasta*, and these were at first regarded as variants only. Out of some hundreds of *hedleyi* collected at Caloundra there was not one beaked specimen. The figure of *fringilla* agrees with the immature of *queenslandica*, but the adult of the latter differs from the present shell. Again a young shell from New Caledonia also closely resembles Angas's figure of *fringilla*, but the adult is very distinct and has been called *nova-caledoniensis* by Angas (' Proc. Zool. Soc. (Lond.) ', 1879, p. 417, pl. xxxv, fig. 2). A specimen so determined, collected at Plum, New Caledonia, by Prof. T. D. A. Cockerell, who generously presented it to the Australian Museum, has a series of strong teeth in a broad arch recalling those of the type of *Veletuceta*, while the teeth of the present species are placed more angulately.

Specimens from Lord Howe Island were returned unnamed by Lamy, but they are very close to *nova-caledoniensis* Angas, and only appear to differ slightly in their weaker teeth and thereby come near to *fringilla* Angas, but they are not so angulate. They may be called *V. fringilla howensis* subsp. nov. as hitherto they have been nameless.

Odhner (p. 8) recorded from Broome, *Pectunculus radians* Lamarck, and (p. 22) from the Pearl Banks off Cape Jaubert, both in North-West Australia, *Pectunculus holosericus* Reeve. Neither of these species occurs in North-West Australia, and a specimen collected by Mr. A. A. Livingstone, at Broome, in 5–8 fathoms belongs to this angulate series. It is large, covered with a periostracum similar to that of *holosericus*, but is angulate, quite like the figure of *queenslandica* here given, to which species it has a very great resemblance superficially, but from which it differs by the fewer stronger teeth, and therefore may be called *Veletuceta persimilis* sp. nov., the type measuring 40 mm. in length by 35 mm. in height.

Veletuceta cotinga sp. nov. (Plate IV, figs. 9, 9*a*.)

This strangely coloured form was at first regarded as only a colour variant, but the coarse teeth at once separate it specifically.

Shell somewhat beaked, inequilateral, equivalve, solid, small, coloration characteristic, hinge teeth few and crass. The beaked half of the shell is whitish, the side of the beak

reddish brown, the white part with lines of zigzag wrinkles, tha rest of the shell uniform reddish brown. Hinge teeth strong, eight on each side, the central pair small, the ligamental area small and somewhat intrusive. The internal coloration is white, save in one instance, and then the posterior is brown, though externally the posterior area is white.

A series of twenty valves was collected at Murray Island, Torres Straits, and every one was similarly coloured. The type, and largest specimen, measured 24 mm. in breadth and 22·5 mm. in height.

The sculpture consists of the usual very fine radial ribs, which are faintly cut into small square nodules anteriorly, but posteriorly the lines being a little distant, and on the posterior area subdued. This same sculpture is seen in the New Caledonian shells noted below, and differs a little from the *fringilla* type, although longer series may modify the differences.

This species was regarded by Lamy (*in litteris*) as *hanleyi*, but the coloration effectually separates it. I recorded ('Rec. Austr. Mus.' XVIII, p. 203, 29th June, 1931): "*V. fringilla* Angas . . . occurs along the mainland of Queensland, and is associated with *V. hanleyi* Angas, described from an unknown locality. If these two should prove identical *fringilla* Angas has both priority and locality, yet it has been regarded as a synonym of *hanleyi*."

Reconsideration of the description and figure of *Axinaea hanleyi* Angas (' Proc. Zool. Soc. (Lond.) ', 1879, p. 418, pl. xxxv, fig. 3) demands its rejection as an Australian species. The figure would bring it into consideration with the shells determined as *fringilla* Angas, which, as above noted, has priority, and therefore disqualifies it, but the coloration is altogether distinct. Specimens from New Caledonia are like this species (*cotinga*), but more orbicular, a little less angularly beaked, and have the same teeth. One specimen from Noumea is whitish, with wavy wrinkled lines all over, and four others are red brown all over, but none are particoloured like the Torres Straits shells. The uniform shells have sometimes been regarded as *Pectunculus spadiceus* Reeve (' Conch. Icon.' I, pl. viii, fig. 47, August, 1843), described from unknown locality, but they differ altogether in shape. Lamy (' Journ. de Conch.', LIX, pp. 109, 124, 1912) has determined the New Caledonian shell as *P. reevei* Mayer (a new name for *P. angulatus* Reeve) from the Philippines, but he confused also *A. nova-caledoniensis* Angas, and our shells do not agree with Reeve's figure in size, shape, sculpture and hinge characters.

The above was written some years before I received Prashad's account of the "Siboga" bivalves, and it is therefore interesting to quote his conclusions, formed at the other end of the world. Under the name *Glycymeris reevei* (Mayer), Prashad wrote (p. 64): "After a careful comparison of the type-shell of *Axinaea hanleyi* Angas, of unknown habitat in the British Museum (Nat. Hist.), London . . . with shells of *G. reevei* (Mayer) I have no doubt that Angas's species is the same as Mayer's species from the Philippines. I have also examined the type-shell of Angas's *A. nova-caledoniensis* and find that it differs from *G. reevei*."

Genus *Tucetilla* nov.

Type: *Glycymeris capricornea* Hedley.

This group will be much more easily understood if it be given a name, and the present confusion may be eliminated.

Shell rather small, a little globose, almost equilateral, equivalved, hinge shallowly

arched, teeth few, margin strongly denticulate, surface sculpture of distant beaded ribs. Hedley described the type-species from the Capricorn Group and determined larger specimens from Caloundra, also in South Queensland, but on the coast, as referable to the same species. The latter were sent to Lamy, who replied that the sculpture was very like that of *tenuicostatus* Reeve, but that the coloration differed, and referred to *crebreliratus* Sowerby as being autoptically unknown to him. Independently I concluded that *tenuicostatus* Reeve was founded upon the coastal species which is fairly common in Moreton Bay. This should be confirmed by criticism of Reeve's type, as Lamy's figure ('Journ. de Conch.' LIX, p. 105, pl. iii, fig. 3, 1912) is unaccompanied by any locality; it is very probably a coastal specimen.

Tucetilla tenuicostata Reeve, 1843. (Plate IV, figs. 11, 11*a*, 11*b*.)

1843. *Pectunculus tenuicostatus* Reeve, Conch. Icon. I, pl. vii, sp. 1, fig. 35, April: Australia (Mus. Cuming).
1899. *Pectunculus crebreliratus* Sowerby, Journ. Linn. Soc. (Lond.), Zool. XX, p. 399, pl. xxv, fig. 20, 31st December: Moreton Bay, Queensland.

As this species commonly occurs in Moreton Bay, it is probable that the type is a shell collected at that locality, perhaps by Strange.

It grows to a much larger size than the reef *capricornea*, reaching 41 mm. × 36 mm. × 23 mm. (complete shell here figured), and differs in shape and the detail of the sculpture as shown.

Tucetilla capricornea Hedley, 1906. (Plate IV, figs. 12, 12*a*, 12*b*.)

1906. *Glycymeris capricornea* Hedley, Proc. Linn. Soc. N.S.W. XXXI, p. 468, pl. xxxvi, figs. 5, 6, 19th November: Mast Head Reef, 17–20 fathoms, Capricorn Group, Queensland.

Hedley's largest specimen measured 12·5 mm. × 11 mm. × 4 mm., single valve, and he suggested it was perhaps immature.

I dredged a good series of valves at North-West Reef in the same group, and at the same depth, 10–20 fathoms, and the largest only reached 20 mm. × 18 mm. × 6 mm. (here figured), so that it appears to be always a small shell.

Odhner ('Kungl. Svensk. Vetensk. Handl. Stockh.' LII, No. 16, p. 22, pl. i, figs. 14, 15, 19th September, 1917) has described *Pectunculus setiger* from 13 fathoms, 48 miles W.S.W. off Cape Jaubert, North-West Australia, which he contrasts with *P. cardiiformis* Angas, but does not mention the present species. A topotype, agreeing with Odhner's description and figure, is superficially so close to Hedley's species that at first sight it seemed inseparable, but the teeth are more numerous, and thus the hinge characters effectually distinguish it. A couple of valves dredged at Lindeman Island have the ribs a little closer together, and more strongly beaded, which indicates how quickly they develop, and the minute sculpture is also a little different; this may be called *T. c. intervenens* subsp. nov., the type measuring 19·5 mm. in length and 17·5 mm. in height.

Genus *Tucetona*.

1931. *Tucetona* Iredale, Rec. Austr. Mus. XVIII, p. 202, 29th June.
Orthotype: *Pectunculus flabellatus* Ten.-Woods.

This generic name was provided for the strongly-ribbed species, the southern shell, *flabellatus* Ten.-Woods, being named as type. The northern reef species have a close

resemblance, though probably they are not strictly congeneric. The generic name is here used tentatively.

The type of *Tucetona* is orbicular, rather flattened, strongly ribbed externally, the ligamental area large, chevron marked, the hinge roundly arched, disappearing medially, the teeth few, distant, scarcely internally denticulate ; internal edge coarsely crenulated muscle scars scarcely elevated, large. The tropical species, *amboinensis*, is very similar in superficial appearance, but the teeth continue under the umbones to meet at a slight discordant angle, the muscle scars a little elevated and the interior striate, the internal edge crenulate. To indicate these distinctions, the subgeneric name *Tucetopsis* is introduced, the type being *Cardium amboinensis* Gmelin.

Tucetona amboinensis extra subsp. nov. (Plate IV, figs. 14, 14*a*, 14*b*.)

1791. *Cardium amboinensis* Gmelin, Syst. Nat. pt. vi, p. 3255, based on Bonann. mus. Kirch. 2, fig. 129, alone : Amboina.

All the Queensland specimens agree in the pattern of colouring here depicted, and differ from a series of shells from the Philippine Islands determined as *amboinensis* in being a little rounder, the ribs a little more elevated, and fewer in number.

Tucetona hoylei superior subsp. nov. (Plate IV, figs. 15, 15*a*, 15*b*.)

When Hedley dredged a series of shells quite unlike any other Glycymerid known to him, he determined from figures that they should be *P. cardiiformis* Angas. The difficulty of gauging the relationships of these bivalves from the figures was proven by the fact that Lamy (' Journ. de Conch.' LIX, p. 93, 1912) decided that Angas's species was a Californian shell. Lamy then rather doubtfully referred Hedley's specimens to *P. hoylei* Melvill and Standen (' Journ. Linn. Soc. (Lond.) ', XXVII, p. 187, pl. xi, fig. 24, 1899) described from Torres Straits.

Hedley's specimens had been dredged in 17–20 fathoms off Mast Head Reef, Capricorn Group ('Proc. Linn. Soc. N.S.W.' XXXI, p. 470, 1906), and the large specimen measuring 47 × 47 × 35 mm. (conjoined valves) is here named as above. *P. hoylei* measured 24 × 25 × 15 mm., and the description is not altogether satisfactory, as the ribs of the southern form would hardly be called " scaly-nodulous ". The ribs, in the specimen figured, number about thirty and are elevated, flattened, straight-sided, with deep narrow interstices, not as wide as the ribs ; the sculpture on the ribs consists of flattened rounded cords, tightly packed.

Genus *Melaxinaea*.

1930. *Melaxinaea* Iredale, Mem. Queensland Mus. X, p. 73, 28th August.
Orthotype : *M. labyrintha* Iredale.

This genus was introduced for the very curious Glycymerid commonly known as *G. vitreus* Lamarck, easily recognized by its shape, flatness, sculpture and especially the hinge teeth, which are numerous and set at an angle to the umbones.

Shell fairly large, suborbicular (sometimes almost eared), compressed, almost equilateral, equivalve, margin coarsely denticulate ventrally, smoothish at each side.

Sculpture of very close-set beaded ribs.

Hinge of many small almost horizontal teeth running straight, and the series angulately meeting each other; in all other groups the hinge teeth form an arch more or less curved.

Melaxinaea labyrintha Iredale, 1930.

1930. *Melaxinaea labyrintha* Iredale, Mem. Queensland Mus. X, p. 73, pl. ix, figs. 1–4, 28th August: Albany Passage, Torres Strait, 9–12 fathoms.

Valves of all sizes were common in the 9–12 fathom dredging off Low Isles. and living specimens were secured at other stations, one from Station XII, 10–15½ fathoms, Penguin Channel, near the mainland.

Lamarck described *Pectunculus vitreus* (' Hist. Anim. s. Vert.' VI, pt. 1, p. 54, July, 1819) from the voyage of Péron, the exact locality being unknown. The single specimen preserved in the Paris Museum was 35 mm. long, or broad, and it was thin and transparent. Reeve (' Conchologica Iconica ', I, Pectunculus, pl. viii, sp. 45, fig. 45, *a*, *b*, August, 1843) figured this unique shell, and being so extraordinary, especially as regards its hinge features, it was at once recognized when re-found. Lamarck's name thus became associated with the Queensland shell, which, however, is only met with in the dredge, and Péron was never in Queensland waters. Odhner (' Kungl. Svensk. Vetensk. Handl.' LII, No. 16, p. 22, pl. i, figs. 12, 13, 19th September, 1917) has recorded Lamarck's species from 8–12 fathoms, 42–45 miles W. of Cape Jaubert, North-West Australia, observing that Reeve's figure seemed to represent an older specimen, Odhner's shell being only 20–22·5 mm. Péron did collect at Shark's Bay. West Australia, so that the original specimen might have come from that locality, but topotypes of Odhner's species prove to have no connection at all with the present species, but are members of the genus *Tucetona*. These are much nearer *amboinensis*, and the name *Tucetona odhneri* is introduced for the West Australian species figured by Odhner as *G. vitreus* Lamarck. Another related species is *Pectunculus montrouzieri* Angas (' Proc. Zool. Soc. (Lond.) ', 1872, p. 613, pl. xlii, fig. 11: New Caledonia), which should be known as *Tucetona* (*Tucetopsis*) *montrouzieri*. On the other hand, Angas described *Pectunculus novaguineensis* (' Proc. Zool. Soc. (Lond.) ', 1879, p. 420, pl. xxxv, fig. 10) from New Guinea, which appears to be a member of this genus, *Melaxinaea*, though not identical with the Queensland shell. Crosse (' Journ. de Conch.' XXVIII, p. 272, 1st July, 1880) renamed Angas's *novaguineensis*, *angasi*, and proposed *A. caledonica* for Angas's *A. novacaledoniensis*—emendations apparently unnecessary. *G. vitreus* Lamarck has been recorded from Mauritius, so that the origin of that species is still in doubt.

Melaxinaea litoralis Iredale, 1931. (Plate IV, figs. 13, 13*a*.)

1931. *Melaxinaea litoralis* Iredale, Rec. Austr. Mus. XVIII, p. 203, 29th June: Townsville, North Queensland.

This fine coastal representative of the genus was diagnosed thus: " It is just as flat as *M. labyrintha* Iredale, and has the same generic hinge line, the teeth numbering twelve or thirteen on each side. It differs at sight in lacking the pronounced ears, being nearly circular, and the sculpture consists of radials, closely packed, with a fine lattice of threads."

The specimens were worn, but the lack of pronounced ears appeared diagnostic; recently some fine specimens were secured on the beach at Seaforth, north of Mackay, and these are not so very different from the reef shell, being only a little less oblique, more circular, and perhaps growing to a larger size and may later be regarded as of sub-specific value. The sculpture is indistinguishable from that of the typical form until a very large size is reached. The largest specimen measures 41 mm. in height, with 44 mm. in breadth, while the type of *labyrintha* gave 38 mm. in height, with only 37 mm. in breadth.

Two worn valves dredged at Station XII, *i. e.* Penguin Channel, appear to belong to this form rather than to the reef one.

The Queensland species may be thus arranged:

Veletuceta hedleyi Lamy	= *australis* Hedley.
	= *grayana.*
	= *holoserica* Shirley.
Veletuceta impasta Iredale.	
Veletuceta fringilla Angas	= *emberiza* Hedley.
	= *hanleyi* auct.
Veletuceta cotinga Iredale	= *angulatus* Shirley.
	= *hanleyi* Lamy.
Veletuceta queenslandica Hedley.	
Tucetilla capricornea Hedley.	
intervenens Iredale.	
Tucetilla tenuicostata Reeve	= *crebreliratus* Sowerby.
	= *striatularis* Shirley.
Tucetona amboinensis extra Iredale	= *pectunculus* Hedley.
Tucetona hoylei Melvill and Standen	= *cardiiformis* Hedley.
Tucetona hoylei superior Iredale.	
Melaxinaea labyrintha Iredale	= *vitrea* Hedley.
Melaxinaea litoralis Iredale.	

Of these the majority favour the mainland beaches, the coral reef forms being *Veletuceta queenslandica* Hedley, *Tucetilla capricornea* Hedley, *Tucetona hoylei* Melvill and Standen, *Tucetona amboinensis* Gmelin, and *Melaxinaea labyrintha* Iredale, only the last two being yet found at Low Isles.

Family Hochstetteriidae.

Hedley described from the dredgings made at Mast Head Isle, Capricorn Group, two small shells which he placed under *Philobrya*, *scabra* ('Proc. Linn. Soc. N.S.W.' XXXI, p. 470, pl. xxxvii, figs. 14, 15, 19th November, 1906), and *recapitula* (*ibid.*, p. 171, pl. xxxvii, figs. 11–13).

The former species is referable to the genus *Cosa*, introduced by Finlay ('Trans. New Zeal. Inst.' LVII, p. 449, 23rd December, 1926), from my manuscript notes, while the latter is here made the type of a new genus *Cosatova*. The development of strong teeth in this species while the shell preserves all the superficial features of the group with only a denticulate hinge line is a factor of importance in the study of the hinge. It may be noted that Bernard began his classical studies on species of this form.

Although these small shells were not secured at Low Isles this is probably only due to chance, as sand dredgings would almost certainly show them.

Order PALAEOLAMELLIBRANCHIA.

The important group of Trigonias, which has been bandied about, is here given ordinal rank, which it certainly deserves. Thiele associated with these shells the freshwater Mussels to form a suborder *Schizodonta*, but there does not seem any relationship between the two. The location, judging by the teeth, may be near the Arks, and the animal features also favour that view. The internal character recalls, perhaps, the Nuculids or the Pearl Shells, but in every real sense the Trigonias stand alone.

The trigonal shape is fairly constant, while the crass hinge is unique, the heavily armed hinge being very peculiar, the internal lustre, with its varying shades of purple to orange, being also unequalled, and then the external sculpture does not ally these with any other group. The early sculpturing in the diverse method seen in the juvenile of the existing species was characteristic in the fossil, and this leads away from any other existing group. It may merely be remarked in passing that March has classed this group at the end of his Heterodonta—an absolutely impossible position from his own premises, as these are certainly not superspecialized Lamellibranchs, but obviously archaic.

Pelseneer ('Treatise on Zoology', ed. Lankester, Part V, Mollusca, 1906), on p. 204, divides the Order Filibranchia into five Suborders—Arcacea, Trigoniacea, Mytilacea, Pectinacea and Dimyacea—but on p. 257 decides that the Order comprises five Suborders —the Anomiacea, Arcacea, Mytilacea, Pectinacea and Dimyacea. It will be noticed that the Anomiacea appears in place of the Trigoniacea, which has been reduced to family rank under the Suborder Arcacea. This cannot be admitted by any conchologist who has any knowledge of Trigoniids, fossil and recent, and therefore an Order equal to that comprising the Arks is provided.

[Family TRIGONIIDAE.

This family is represented in Australian waters by the only existing species, which are now ranged under the genus *Neotrigonia* Cossmann ('Ann. Paleont.' VII, p. 81, July, 1912). They live in sandy ground and no specimens were secured at Low Isles, nor in the Expedition dredgings, but species occur along the Queensland coast, a beautiful form having been dredged by Jukes off Cape York in 6 fathoms of water. It was named twice, Gray calling it *Trigonia uniophora* in 1847 ('Narr. Voy. "Fly"' (Jukes), II, App. p. 361, pl. ii, fig. 5), and A. Adams, *T. jukesii* in 1850 ('Proc. Zool. Soc. (Lond.)', 1849, p. 159, Moll., pl. iii, figs. 4, 5, June, 1850).

Since the Expedition it has been proved that it was mere chance that specimens were not secured, as members of the genus have been dredged by Messrs. Melbourne Ward, G. P. Whitley and myself at North-West Islet, Capricorn Group, and at Lindeman Island, Whitsunday Group. The specimens from Lindeman Island represents a small ally of the northern species, while those from North-West Islet are small relations of the southern species. Thus we have now three species in Queensland waters extending the whole coast-line of Queensland, as previously odd dead valves had been picked up at Moreton Bay.]

Order PSEUDOLAMELLIBRANCHIA.

The name of this Order suggests doubtful relationship, and, as used by Winckworth, includes the Pearl Oysters, Oysters, Fan Shells, Scallops and Limoid species. These constituted, with the Mussels and Window Pane Shells, the Order Anisomyaria of Thiele, which is the same as that of Cossmann and Peyrot. The latter regarded this same series as a Suborder with the name used by Winckworth. It may be of interest to note that the author of this group, Pelseneer, discarded it on the first criticism of its heterogeneous content, but later revived it, acknowledging, however, its instability. Thiele separated his Order into lesser groups, which he called " Stirps ", indicating four: Mytilacea, with one family, Mytilidae; Pteriacea, with three families, Vulsellidae, Pteriidae and Pinnidae; Pectinacea, including three families, Dimyidae, Pectinidae and Limidae (the family Pectinidae being subdivided into four subfamilies, Plicatulinae, Amussiinae, Pectininae and Spondylinae); and Ostracea for the family Ostreidae.

Cossmann and Peyrot had called these divisions " Cénacle " with the same names, the Mytilacea, however, being divided into three families, Mytilidae, Dreisseniidae and Prasinidae; an extra family, Pernidae, was allowed in the Pteriacea, and a family Spondylidae was also recognized in the Pectinacea.

The name Pseudolamellibranchia is here utilized with reserve as an ordinal one for the Pearl Shells, Fan Shells, with the Scallops and their allies, Dimya, and the Oysters. The Window Pane Shells and their relations are given ordinal rank, with the name Parafilibranchia, while the Mussels are also separated as an order, with the name Isofilibranchia.

Suborder PINNIFORMES.

The Fan Shells constitute a well-defined group, with very well-defined characters and obscure relationship, save that it seems distantly related to the Pearl Shells in the widest sense. On account of their large size and frailty they have been little studied, but there is a great opportunity for someone to examine them in nature, as there are apparently diverse stocks confused. The differences here ignored would be accepted as of family value in other places. The whole animal system varies in some species, and a detailed examination might reveal astonishing results.

Family PINNIDAE.

These large brittle shells, so difficult to preserve, have not been attractive objects to collectors, and thus have been neglected until comparatively recently.

One of the last papers prepared by Hedley on his favourite study was a " Revision of the Australian Pinnidae " (' Rec. Austr. Mus.' XIV, pp. 141–153, pls. xix–xxi, 26th June, 1924), and, through this account, intensive collecting has taken place since locally. consequently much more material and information are now in hand than were available to Hedley, and will be here utilized. Species have been found to be even more local and more easily separated than even Hedley admitted, and their characters appear to be comparatively stable, though breakage in growth through their frail nature may at first suggest the opposite. Curiously, Winckworth, dealing with Marine Mollusca from South India and Ceylon some years ago, (' Proc. Malac. Soc. (Lond.) ' XVIII, pp. 276–297,

November, 1929) concluded that they showed great variation and that the species had enormous range, quite contrary to Australian experience. It is unfortunate that Winckworth altogether overlooked Hedley's essay, while his aggregation of species from various localities under one specific name seems to be a retrograde step in the study of these difficult molluscs. Winckworth gives a List of Recent Species of Pinna, totalling one hundred and seventy-five names, including many misprints, but regards only twenty-nine as representing valid species. This seems obviously a *reductio ad absurdum*, and is probably as far from the true facts as the total number of names is. This is borne out by the inclusion in synonymy of well-marked species through the misusage of analogy in correlating the limits of specific variability. It is definitely true to-day that only the local student with continued access to fresh material can gauge the variation of his local forms, and that this variation is not calculable from analogy. As examples, the species *menkei* is very easily recognizable, showing little variation, while the species "*deltodes*" only shows the deltoid form as a rare occurrence or juvenile shell, mature specimens being generally very distorted and misshapen, yet giving the specific characters of flaking, colouring, texture and nacreous scars. In connection with the last-named feature Winckworth seems to stress its constancy, but it appears to be a variable feature, or otherwise Winckworth's lumping is very much at fault. When it is realized that in connection with British Mollusca Winckworth has recognized species separated only by means of study of their faecal pellets, it is an extraordinary corollary to find him associating so many diverse forms without any good reason.

Winckworth studied the Pinna fauna of southern India and then attempted to determine the species elsewhere existent from inspection of a few museum specimens. It is quite impossible to-day to treat marine molluscs in this manner, and all studies save by local students must be regarded with grave suspicion. With ample material from many points on the Queensland coast and the Great Barrier Reef, it has been found a difficult task to determine the species. The only method that has proved successful has been the careful criticism of a series from any given point where only one species has been found living. With such results it has been a matter of judgment in the discrimination of the range and relationships of the known specific form. Some forms are much more liable to individual variation than others, and Dr. Dall observed that the variation was explicable as follows: "If the ground be hard and stony, the shells become short and wide and tend to be irregular or distorted; on soft ground they attain normal growth, inclining to be elongate, while in still water and on a sandy floor the scales and spines are most developed." This statement has been quoted as if generally applicable, but it has no meaning, save locally, the species differing in their reactions to their environment, and it does not accord with Australian species.

Since my account of the Pinnidae was prepared I have collected and re-examined more material, and my conclusions have been upheld with very little emendation. In the 'Proc. Mal. Soc. (Lond.)' XXII, pp. 20–33, 14th March, 1936, Winckworth has given some additional notes, especially noting Hedley's paper, and commenting: "Hedley was a talented zoologist and ecologist, whose systematic papers are excellent, but I do not think he fully realized the very great range of variation in most species of *Pinna*, or that he was justified in separating *atropurpurea*, *fumata*, *menkei* and *molluccensis*, for example." This will do as an example to emphasize the point I am attempting to make: that no extralimital zoologist, however able he may be—and I have more respect for the ability

of Winckworth than most—can realize the problems of the Australian zoologist and ecologist. I am not concerned with the variation of members of the Pinnidae in India; I leave that to the local worker with local knowledge of conditions—a very necessary matter; but I can state that in Australia *menkei* and *fumata* are two distinct entities, whatever their relationship to the missing *atropurpurea* and the dubious *molluccensis.* With regard to the ecology of the group, Winckworth has noted that his brother in India "also comments that as a rule the shell of *Pinna* only protrudes just above the surface", and notes later, "Hedley—under the name *scapula* . . . describes an interesting abnormal *bicolor* which was rooted no deeper than the byssus . . . ".

The species of the family all show different growth methods, and can be identified without collecting by this means. It is well known that they grow together in colonies in which two or even three species may be represented. The form which Winckworth refers to as "*bicolor*" always grows well out of the sand, as Hedley states, "rooted no deeper than the byssus", and hence is very liable to fracture and distortion. Other species may be seen half out of the sand, while others are nearly completely buried, as Winckworth *frère* states. These facts are always taken into consideration when collections are studied, and nothing is done here without knowledge of individual variation as contrasted with geographical variation.

It may be recorded that the form of the Pinna may depend altogether on the animal, which has been so neglected that the great differences seen in the muscle scars and nacreous patches are simply ignored. Yet these are of great importance when the animals are seen in natural conditions, and the animals themselves are superficially separable without much examination.

Winckworth has given figures of the interiors of right valves of four species of *Pinna* showing extent of nacre, muscle scars and anterior loculi. As he has lumped so many species it can only be conjectured that his drawings were made from his own specimens from Indian localities so determined. Thus he gives figures of "*atropurpurea*" and "*bicolor*", which he separates by means of these internal features. But in his synonymy of *atropurpurea* he includes many species whose muscle scars may differ. Thus, in Australia, *menkei* and *madida* differ in this respect, though both are subordinated to *atropurpurea* by Winckworth.

The internal features may assist after the species have been separated by external features, but only then. Among the Pinnoid species the scars shown by Winckworth appear to indicate distinct groups, which I am regarding at present as genera and distinguish thus:

Shell very small, thin, triangular, the posterior extremity truncate, nacreous patches ill-defined, muscle scars delicately impressed, internal division narrow, linear, limbs subequal, extremities squarish or little rounded. . . . . *Quantulopinna.*

Shell large, irregularly fan-shaped, of medium thickness, dorsal side longer than ventral edge, muscle scars well marked . . . . *Subitopinna.*

Shell long, very thin, narrow, smooth, the inner crack forming the linear division of two subequal long angulate muscle scars . . . . *Cyrtopinna.*

Shell medium, thick, broad, surface never prickly, the shape irregular, the muscle scars rather widely separated, inner scar broad, extremity rather square, outer one shorter, narrower and rounded *Exitopinna.*

Shell large, thick, convex, ham-shaped, black, extremity very rounded, no crack, muscle scars placed at less than half the length of the shell, the large adductor median and limital . . . . . *Atrina.*
Shell smaller, thin, extremity squarely truncate, no crack, muscle scars extending two-thirds the length of the shell, the large adductor median, not limital . . . . *Servatrina.*
Shell small, thin, very irregular in shape, twisted, muscle scars very small, not much more than one-third the shell . . . . *Streptopinna.*

Genus *Pinna.*

1758. *Pinna* Linné, Syst. Nat. 10th ed., p. 707, 1st January.
1806. *Pinnarius* Dumeril, Zool. Anal., Index, p. 340: ed. Froriep, p. 169, 1806; new name for "*Pinna.* Cuv.".
Haplotype: *Pinna rudis* Linné.
1815. *Pinnula* Rafinesque, Analyse Nat. p. 147, 1815: new name for *Pinna. Cf.* Iredale, Proc. Mal. Soc. (Lond.). IX, p. 262, 1911.
[1791. *Chimaera* Poli: Winckworth, Proc. Mal. Soc. (Lond.). XVIII, p. 282, November, 1929. Type: *Pinna nobilis* Linné.
[Rejected as nomenclature non-Linnean.]

The type of *Pinna* Linné is generally accepted as *Pinna rudis* Linné, but the determination of the species is at issue. Hedley contended that the Red Ham Shell from the West Indies figured by Chemnitz as Linné's species and so accepted by Lamarck was a misinterpretation, and that *carnea* = *flabellum* Lamarck was the Linnean *rudis.* Winckworth allows *carnea* Gmelin as a distinct species, and under *rudis* Linné states, "The West Indian species commonly so-called must take this name", which does not agree with either of the Linnean figures cited. Apparently Hedley concluded there are only two claimants, the Rumphian figure and the Argenville one, and the latter, agreeing with the West Indian "*flabellum*" = *carnea*, alone satisfies the description. Consequently unless this "*flabellum*" is the immature of "*rudis*", the type of *Pinna* is not the well-known West Indian shell so-called. It is as well that the Rumphian species is ruled out, as that is an "*Atrina*", not a *Pinna* as commonly recognized. It is again fortunate that the exact interpretation of Linné's *P. rudis* is of little account here, as no Australian species is at all closely related to either of the contestants.

Winckworth wrote, "the type species [of *Pinna*] is *P. rudis*, L., selected by Children in 1823". This is incorrect, as Children *never* selected a type of a *Linnean* genus, only indicating "types" of *Lamarckian* genera of the 'Histoire Animaux sans Vertèbres', and then only taking the first species in that work, though Lamarck had previously introduced the generic name with a different species as sole occupant. The only cases where Children's designations can be used are in connection with the genera introduced in the 'Histoire', and even in those cases there are complications, as Children states the "type is so-and-so: Lamarck's type is another shell", and also, "I have selected this type as the true type is not available for illustration", indicating that his usage of the word "type" was not as we rigidly construe the word to-day.

Grant and Gale ('Mem. San Diego Soc. Nat. Hist.' I, p. 144, 3rd November, 1931) have proposed that *Pinna muricata* be regarded as type of *Pinna* by the usage of Linnean tautonymy. They arrive at this conclusion by interpreting "Concha pinna Hasselquist" as a justifiable tautonym, which is here not accepted. As a matter of fact they cannot

determine *Pinna muricata* Linné, though obviously, if their own arguments were valid, it could be nothing else save Hasselquist's shell. Linné refers to the Mediterranean history in connection with *Pinnotheres*, and gives the locality as " M. Mediterraneo ". Hanley discoursed learnedly concerning this species, but ignored Hasselquist altogether, and concentrated on the later description in the " Museum Ulricae ", which in this case does not really enlighten us. The whole of Linné's original description reads : " P. testa striata: squamis concavis ovatis acutis." Bucquoy, Dautzenberg and Dollfus, in their inestimable work on Mediterranean shells, ' Les Mollusques Marins du Roussillon ', noted *Pinna* as far back as Aristotle, and continued through Aldrovandi, Belon and Rondelet to Linné, and then admitted two species, *P. pectinata* Linné and *P. nobilis* Linné. The former, generally smooth, was allowed a spinose variety which had been regarded as Linné's *muricata* by British conchologists as Da Costa, Donovan and Montagu, but Turton had referred it to *pectinata*. Linné distinguished *pectinata* in the twelfth edition only, introducing the name for a shell figured by Gualtieri from " India ", and Winckworth has concluded that the illustration better displays the Indian shell than the European, to which the name *pectinata* has improperly been applied.

Rejecting Children as a legal type designator of Linnean genera, we find Anton, in 1838, selecting *seminuda* Lamarck, which, of course, has no standing in the case at all, and thus we are left with Gray, whose action had been generally accepted without question until these doubtful actors, Schumacher, Schmidt, Children, Anton were produced upon the stage. Winckworth discusses the Polian names, and noting that Poli, observing the insufficiency of Linné's descriptions of the animals of shells as *Doris*, *Limax*, *Tethys*, proposed new generic names for the soft parts of bivalves. Linné's *Doris*, *Limax*, *Tethys*, of which Poli's names were equivalent, are NOT recognized as generic names, *and neither should Poli's.* Linné used *Doris*, *Limax* and *Tethys* as generic names *also*, and these are the genera of Linné, but Linné's usage of these names for the animals of his other molluscan genera is not accepted, *and neither can Poli's be so.* This can be proved by reading Linné, whose first genus of Testacea is *Chiton*, with a definition "Animal *Doris*"; upon referring to the characters of the *genus Doris* (p. 644) we read, " Doris Corpus repens, antice Tentaculis 8 ". The animal of *Chiton* does not agree with this definition, and the *Doris* under *Chiton* is obviously not a generic name, and Poli's names ally themselves with such names, and are definitely not generic. Having differentiated the animals under these zoological terms, Poli, recognizing that they were not genera in the Linnean sense at all, introduced additional generic names for the shells harbouring the animals zoologically studied. Winckworth has reversed this, and suggests treating the animal names as properly proposed genera, and the generic names as zoological terms—a conclusion at variance with the facts as given here.

Genus *Quantulopinna* nov.

Type : *Q. delsa* sp. nov.

Shell small, elongately trigonal, thin, posterior squarely truncate, longitudinally ribbed, ribs bearing prickles. Shell imbedded nearly all its length, the animal medium, the muscle scars extending beyond half the length of the shell. Dorsal scar with semi-rounded edge, the muscle impression below the edge, the ventral scar not reaching quite as far, with a very narrow groove between.

Quantulopinna delsa sp. nov. (Plate IV, fig. 16.)

A common small *Pinna* resembling Hedley's "*isosceles*" is apparently unnamed. Hedley included, under his new species described from Port Jackson, specimens from Lord Howe Island, adding, "This species has been mis-identified as *Pinna zealandiae* and *P. muricata*". Winckworth has utilized *Pinna muricata* as of Linné, citing *P. semicostata* Conrad as the only synonym, for Indian shells, and giving the Lord Howe Island locality. Although Winckworth suggests "I do not think my use of Linné's name need be questioned", there seems every reason to doubt his application.

Linné's first reference is to Lister, who figures two shells from "Barb" and "Jamaica", obviously the first being the shell named by Lister "Pinna tenuis striata muricata", and from which Linné took his specific name. This has first claim and can only be rejected on account of Linné's locality, "M. Mediterraneo", but such a conclusion would at once disqualify the reference to Rumph, whose shell was from Amboina. This leaves Hasselquist as the only reference satisfying both description and locality, and this should be maintained in preference to the one used by Winckworth.

Winckworth's decision reads, "The original *muricata* then is a mixture of *semicostata* with other species (Lister and Hasselquist references)"; that is, he eliminates the two references upon which Linné's *muricata* is primarily based, the specific name having been taken from the first place and the general account from the other, whose locality is the only one cited. Hedley introduced *isosceles* ('Rec. Austr. Mus.' XIV, p. 145, pl. xix, fig. 1, 26th June, 1924: Port Jackson, N.S.W.) for the species resembling *semicostata* Conrad, but unfortunately he confused some aberrant local specimens of *menkei* with the Lord Howe Island shell, and selected as type a Port Jackson shell. Thus the name *Pinna isosceles* falls as a synonym of *menkei* Reeve. The Queensland shell, now described as *Quantulopinna delsa*, is very small for the family, triangular, thin, a little prickly, the prickles on alternate ribs only at the posterior end of the shell, and commonly nearly obsolete. The coloration is pale horn, more or less blotched with purple, clearly seen in the interior. It lives among coral blocks and its distortion is restricted, due to its environment, so that it is comparatively constant. The Queensland form is narrow, while the Lord Howe Island form is larger, broader and less prickly and may be called *Q. d. howensis* subsp. nov., the length being 160 mm., the breadth 80 mm.; the shell figured from Low Isles has a breadth of 54 mm. with a length of 120 mm., the extremity squarely truncate.

The only synonym of *Pinna muricata*, as used by Winckworth, is *semicostata* Conrad, of which Winckworth himself wrote, "Conrad described what is probably this species from the Sandwich Islands". Recent investigators of the molluscan fauna, *i. e.* Dall and Pilsbry, have decided that the species, from the Sandwich Islands, differ specifically from similar shells in other Pacific groups, so that *semicostata* Conrad will be eligible for the Sandwich Island species. There is a name *nebulosa* Solander, cited by Dillwyn ('Descr. Cat. Recent Shells', I, p. 328, 1817) as a synonym of *muricata*, with the note, "It appears from his MSS. that Dr. Solander considered *P. squamosa* to be the Linnean *P. muricata*, and that the present shell is his *P. nebulosa*, but the latter agrees best with the description, which Linnaeus has given in his account of the Museum of the Queen of Sweden".

Genus *Subitopinna* nov.

Type: *Pinna menkei* Reeve.

Shell large, solid, irregularly shaped, the outer or dorsal margin a little exceeding the inner or ventral margin, the posterior extremity rounded. Sculpture of longitudinal flat ribs rarely becoming obsolete, rarely developing scales. The muscle scars exceeding more than half the length of the shell, which is generally entirely embedded in life ; edges of both scars subangulate, sloping inwards to the narrow groove, which separates them, the muscular impression being below the extremity of the scar.

Subitopinna menkei Reeve, 1858.

1858. *Pinna menkei* Reeve, Conch. Icon. XI, Pinna, pl. xviii, fig. 34, June, ex Hanley MS. : No locality given.
1858. *Pinna menkei* Hanley, Proc. Zool. Soc. (Lond.) 1858, p. 228, November : Port Jackson, New South Wales.
1924. *Pinna isosceles* Hedley, Rec. Austr. Mus. XIV, p. 145, pl. xix, fig. 1, 26th June : Port Jackson, New South Wales.
1924. *Pinna menkei* var. *caviterga* Hedley, Rec. Austr. Mus. XIV, p. 147, pl. xx, fig. 8, 26th June : Fraser's Island, Queensland.

Owing to the fact that Smith had regarded the Fraser's Island specimen as a variety of *menkei*, and as Smith's ideas of specific value were almost as broad as Winckworth's, Hedley named the shell varietally, but it appears to be merely an abnormal form. It is, however, from the northern extremity of the range of this species, and it may be that series will allow its use subspecifically later. Hedley's further north records of Cape Flattery and Gulf of Carpentaria do not apply to this species, nor are his remarks, as follows, correct : " This seems to be a common shell in Queensland, which, exceptionally and in a dwarfed condition, may reach as far south as Sydney." This is the only common Sydney species, and specimens measuring up to 360 mm. in length have been collected here.

It is quite distinctive in its form, coloration and sculpture, although it was described from a rather distorted specimen. Hedley named *Pinna isosceles*, intending his name to take the place of " *muricata* ", but unfortunately he selected as type a small compressed specimen of this species.

Hedley synonymized with *menkei* two Reevean species, *euglypta* and *vespertina*, the former from Amboyna, the latter from unknown locality, neither of which are by any means conspecific. Winckworth made both these synonyms of *atropurpurea* Sowerby, along with over a dozen other names including also *menkei*, explaining, " The locality of *menkei* is given as Port Jackson by Hanley, but as ' Hab. ? ' by Reeve : I have this form too from Trincomali, so that either the range of this species extends unusually far south, or the locality given is not reliable." The locality appears to be reliable, but definitely Winckworth's record of this local species is inadmissible.

Winckworth's conglomeration of specific names under *atropurpurea* forbids the possibility of determining what the true *atropurpurea* may be like. This was described in the Appendix, p. v, of the ' Cat. Shells Coll. Tankerville ', and there is nothing in the description exactly to determine the species. Hanley describes and gives a figure of a shell only 6 inches long from the " Indian Seas ? ", while Reeve figures a

different specimen, over 7 inches long, from Amboyna, neither agreeing in shape with Winckworth's figure, possibly 12 inches long.

Winckworth stated that the type was in the British Museum, but probably he was only thinking of Reeve's expression of Sowerby's species, as the Tankerville collection was dissipated by sale. and such a shell as a *Pinna* would pass into oblivion, very little interest being taken in the group. Hedley's Australian record of *atropurpurea* was based on a small shell resembling Reeve's figure, but which appears to belong to a species representing *madida* Reeve on the Queensland coast.

Subitopinna madida Reeve, 1858.

1858. *Pinna madida* Reeve, Conch. Icon. XI, pl. xvii, sp. and fig. 31, June: Port Essington, New Holland.

Hedley used this name for specimens from Port Curtis, Bowen, and Karumba, *i. e.* coastal Queensland.

Winckworth included it doubtfully in the synonymy of *atropurpurea* Sowerby, which Hedley had admitted to the Queensland List, on the basis of a single specimen from Cape Flattery. A specimen was collected north of Cape Bedford, and a series from Keppel Bay has been sent by Mr. H. Bernhard.

The shell is elongate, bluish black, the dorsal margin straight, curving gently towards the ventral margin, which continues without break. The sculpture is of very weak longitudinals, which become obsolete at an early stage, and hence no prickles eventuate. As the shell is only embedded for a very short time three-quarters of the length of the adult is covered with growth and bears serious records of fractures, but is not commonly distorted. The muscle scars agree fairly with those of the preceding.

Pinna fumata Reeve, 1858.

1858. *Pinna fumata* Reeve, Conch. Icon. XI, pl. xv, figs. 27, 28, May: Zebu Island, Philippines.

Melvill and Standen recorded this species from Torres Straits, and Hedley admitted it, adding a record from Darwin. Nothing exactly like Reeve's figures has been yet seen, and the name can be eliminated. Winckworth made this species also a synonym of *atropurpurea*, and while we may have in Queensland a species representing *atropurpurea* as figured by Winckworth, we have not anything like *fumata* at present. That is, as well as *menkei* and *madida*, there is probably a third species of Winckworth's *atropurpurea* medley living in Queensland waters as a distinct entity.

[*Pinna virgata* Menke, 1843.

1843. *Pinna virgata* Menke, Moll. Nov. Holl. Spec. p. 36, April: West Australia.

Hedley figured a South Australian species under this name, observing that Reeve's interpretation was incorrect. Winckworth includes the name as perhaps " *atropurpurea* " but apparently did not read Menke's description. That requires a shell " 9½ inches long, thin ", " fulva ", " squamis fornicatis brevibus confertissimis, transversim seriatis muricata " , and is compared with " *Pinna rotundata* L.". Such an account is not reconcilable with any " *atropurpurea* ", even allowing Winckworth's aggregation of

forms. It is suggested that an ally of *Pinna assimilis* Reeve would better answer, save that the size is greater than usual in that group.

Cotton has suggested that *Pinna virgata* Menke be referred to the synonymy of *Pinna dolabrata* Lamarck, but he was only concerned with the South Australian shell so-called by Hedley. The species is here introduced, as Martens regarded *virgata* Menke as equivalent to *menkei*, with which it obviously has nothing whatever to do.]

Subitopinna ? molluccensis Clessin, 1891.

1891. *Pinna molluccensis* Clessin, Syst. Conch. Cab. (Mart. and Chem.), cont. ed, Kuster, Band VIII, Abth. 1 (Heft XXXIII), p. 82, pl. xxxiii, fig. 1, July: Moluccas.

Shirley recorded *Pinna angustata* Lam. from Torres Straits, and Hedley included it in his list under the name *P. moluccensis* Clessin. The latter name was given by Clessin to the species figured by Reeve from the Moluccas as *P. angustana*, which was not Lamarck's species of that name. Reeve's figure shows a small shell, rather triangular and bearing coarse prickles, with the appearance of a juvenile specimen. There is no shell available from Queensland at present at all like this figure, but Mr. A. A. Livingstone collected a shell at Broome, North-West Australia, which superficially recalls it, so that there may be a similar shell on the western side of Cape York, where Pinnas are abundant, as reported by Mr. Robin Kemp, from Utingu, many years ago.

Genus *Cyrtopinna*.

1853. *Cyrtopinna* Mörch, Cat. conch. Yoldi, pt. II, p. 51, April.
Haplotype: *Pinna incurvata* Chemnitz = *Pinna incurva* Gmelin.

Shell very elongate, narrow, thin, shining, smooth, clean, thus indicating almost complete covering in life. The dorsal margin is very long, and the curve joining its extremity with the ventral margin rather steeply curved and continuous. The muscle scars are long and pointed, practically of equal length with a very narrow groove between, the muscle impression being below the curve, and the scar reaches just about half the length of the shell. The median crack is elevated, so that the sides become angular and, with age, so steep that the shell breaks at the junction very easily.

Cyrtopinna stutchburii Reeve, 1859.

1859. *Pinna stutchburii* Reeve, Conch. Icon. XI, pl. xxxiii, sp. and fig. 64, February: Moreton Bay, Australia; Stutchbury.

Hedley followed Martens and synonymized this species with the prior *attenuata* Reeve, from the Moluccas, but our species does not show the strong ribbing of the figure of the Moluccan species. Hedley had no specimens, but, since, Mr. Melbourne Ward and W. Boardman have dredged some dead specimens in 9–12 fathoms in Port Curtis, and Mr. H. Bernhard has sent a beautiful series from Keppel Bay, Queensland.

Winckworth records "*attenuata* × *stutchburii*" from Ennūr, near Madras, and Tuticorin, but as he writes "closely related to the last three species", viz. *bicolor*, *muricata* and *atropurpurea*, his valuation is discounted, as no characters recall the small prickly triangular "*muricata*". As indicating that his Indian species, whatever its name, is quite distinct from the Australian, the nacreous scars may be cited. In the local shell

the median groove separates two equal lobes, which extend laterally to a point on each side, and refer it to *Cyrtopinna*. but Winckworth allows the type of *Cyrtopinna* as a distinct species from "*attenuata* × *stutchburii*", from the same locality, Ennūr.

Genus *Exitopinna* nov.

Type: *E. deltodes ultra* nov.

Shell stout, broad, short, buried only to its byssus, so that nearly the whole of the shell is above the sand, and thus very liable to breakage and distortion. The juvenile starts as a longish triangle, but soon broadens and then shows signs of fracture continuously, the outside normally showing a flaky series of growth-lines. The juvenile sculpture is of a few broad obsolete ribs overridden by fine transverse threads, and is bluish brown, the inside shining bluish black with a brown under-colouring, which predominates at the margins. The muscle scars are distinctive, the dorsal scar extending more than half the length of the shell, and broadening and being sharply truncate along the muscle impression extremity. The ventral scar is notably shorter with a rounded end, and there is rather a wide gap between the two scars.

Exitopinna deltodes ultra subsp. nov. (Plate IV, fig. 17.)

A specimen from Batt Reef, collected by G. P. Whitley, resembles Reeve's figure of *deltodes*, but it shows a very bad breakage right across just above the byssus, and all the regular growth is comparatively new. A Low Isles specimen shows more the shape of Hedley's *scapula*, and is here figured.

A good series from H. Bernhard, collected at Keppel Bay, Queensland, from young to adult show a young triangular shell developing into a broad ham, and linking up with the Low Isles shell. All are darker than the Western shells, thicker, and less sculptured. Another very fine series has been procured at Lindeman Island, by Mr. Melbourne Ward, and these show the specific features clearly, thought no two are exactly alike in shape owing to their growth methods. They live among stones in the mud, and are only imbedded for about one-third their length, the exposed portion thus being liable to fracture by stones moved with the wind and tides.

Pinna deltodes was described by Menke ('Moll. Nov. Holl. Spec.' p. 37, April, 1843) from near the mouth of Victoria River, North-West Australia and a topotype received from Menke was figured by Reeve ('Conch. Icon.' XI, pl. xxi, sp. 40, June, 1858). A series collected by Mr. A. A. Livingstone, of this Museum, at Roebuck Bay, North-West Australia, shows variation, from broad to elongate, from triangular to ovate, with much breakage and repair, yet all the time leaving no doubt as to their specific identity from their juvenile form, their peculiar coloration and the nacreous scars, the curious external flaking being diagnostic. Only the younger shells resemble the figured *deltodes* in form, and rarely does a full-sized one retain the juvenile form.

As discussed hereafter, Born's *vexillum* appears to have been based on a shell belonging to this series, and therefore would belong to the Pinnoid series, not in *Atrina*, where Hedley and Winckworth has classed it, the latter even giving it as the name of the type of *Atrina*. Hedley described a malformed specimen from Darwin as *Pinna scapula* ('Rec. Austr. Mus.' XIV, p. 148, pl. xix, figs. 4, 5, 26th June, 1924), and this

Winckworth, in his "Further Notes", has cited as another synonym of his multifarious "*bicolor*", with which it has no relationship. As Winckworth allowed *deltodes* as one of his few recognizable species, this serves as a good example of the futility of lumping.

Genus *Atrina.*

1842. *Atrina* Gray, Synops. Contents Brit. Mus. 44th ed., p. 83, diagnosis only, ex 42nd ed., p. 151, 1840, *nom. nud. Cf.* Iredale, Proc. Mal. Soc. (Lond.), X, p. 303, 1913.
1847. *Atrina* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 199, November.
Orthotype : *Pinna nigra* = Dillwyn, *i. e.* Chemn. VIII, p. 221, pl. lxxxviii, fig. 774.

This division of the Pinnidae is also of more than generic value, as the species, hitherto included in it as a subgenus differ in essential features, such as shape, solidity and muscle scars. The heavy solid black species agreeing with the type are very different from the thin pale-coloured shells, also showing no medial crack. Hedley gave a figure of the interior (pl. xx, fig. 12), showing the nacreous extent, with the muscle scar central and at the apex exactly where there is no scar at all in true Pinnoid shells.

Atrina gouldii banksiana subsp. nov. (Plate IV, fig. 18.)

1858. *Pinna gouldii* Reeve, Conch. Icon. XI, pl. xi, sp. 21, ex Hanley MS., May : Loc. ? = Amboyna, *fide* Hanley, Proc. Zool. Soc. (Lond.) 1858, p. 255, November.

Hedley figured and described a shell from Queensland as *Atrina gouldii*, but doubted the accuracy of the association. He mentioned that Brauer had accepted Reeve's figure as representing *vexillum* of Born, but rejected the alliance on the ground of incompatibility of contour and sculpture. Hedley identified *vexillum* of Born with *nigra* Reeve, and included *nigra* Dillwyn on Melvill and Standen's record as a distinct species. Consequently in his account *Atrina gouldii* Reeve, *Atrina nigra* Dillwyn and *Atrina vexillum* Born all refer to the same species, but the last two names do not seem applicable. Born's *Pinna vexillum* was based on a distorted brown smooth shell from unknown locality. Winckworth has synonymized with it *exusta* Gmelin, a sculptured brown shell, *adusta* Dillwyn is equivalent, *gubernaculum* Bolten also given to a brown shell and *nigra* Dillwyn based on a black shell, *nigrina* Lamarck being the same as Dillwyn. Winckworth then wrote : "The dark almost black colour of the shell is a good specific character", practically negativing the above synonymy. I would therefore reject *vexillum* Born as it calls for a "fuscus" shell, which is assuredly not black, while "laevi" is not strictly applicable either. But the illustration is decidedly not of the black shell, the *Atrina*, but is almost certainly the brown shell referred to previously as *deltodes*. The words apply, and the flaky appearance is distinctive, while the distortion is almost restricted to that species, and so far has never been seen in any "*vexillum*" shell.

The black *Atrina* occurred on Low Isles and has since been collected along the Queensland coast. The shell figured is a nice young one collected at Low Isles, and is about 110 mm. in extreme length, with about 60 mm. in breadth. The earliest ribbing is of raised flattened distant ribs, about seven in number, the ventral area being smooth. With age the main ribs develop prickles, while subordinate minor ribs appear. The ventral side also develops fine prickles not in definite rows. A larger specimen from Batt Reef is also developing a prickly ventral surface and is expanding ventrally. Other adult

specimens from the Outer Barrier Reef collected by Dr. Paradice are of similar form and also show the prickly ventral surface, the prickles well developed.

Genus *Servatrina* nov.

Type: *Pinna assimilis* Reeve.

The species allotted to *Atrina* by Hedley in Australian waters are easily separable into two series, one, large and solid, the other small and thin. These also show differences in shape and growth-stages and muscle scars. Mörch separated this group under the pre-Linnean name of *Pennaria*, which had been otherwise utilized before Mörch legitimized it, so that it is still nameless. Martens also recognized the group as natural, but Winckworth and Hedley submerged it under *Atrina*. It is probably the most distinctive of all Pinnoid groups, and a series of juvenile shells of very small size show all the adult features.

The shell is small, thin, and characteristically shaped, the extremity of the dorsal margin being the highest point, the posterior margin being squarely truncate. Coloration always pale brown, never black. The muscle scar is central, but is exceeded by the nacreous patch, whereas in *Atrina* the muscle scar is almost external.

Servatrina strangei Reeve, 1858.

1858. *Pinna strangei* Reeve, Conch. Icon. XI, pl. xxvii, sp. 52, ex Hanley MS., August: Moreton Bay.

Both Hedley and Winckworth follow Reeve in placing *hystrix* Hanley as a synonym of *strangei* Reeve, but Hanley's species was from Amboyna, and we do not get a spinous shell of the *strangei* type in Queensland. There are, however, shells in this Museum from New Caledonia which are even more prickly than the Reevean figure, and which otherwise agree, and these are certainly separable specifically from *strangei* Reeve. Curiously Winckworth allows this specific rank, while lumping a similar series of smooth to prickly shells under *pectinata* Linné, showing more variation *inter se* than *strangei* varies from *assimilis* in Australian waters.

The shape of *strangei*, as well as the lack of prickles, separates this species easily.

Servatrina assimilis Reeve, 1858.

1858. *Pinna assimilis* Reeve, Conch. Icon. XI, pl. xxxi, sp. 59, August, ex Hanley MS.: Raine's Island, North Queensland.

1858. *Pinna assimilis* Hanley, Proc. Zool. Soc. (Lond.) 1858, p. 255, 9th November: Port Essington.

Although Reeve used Hanley's specific name he did not describe the same shell, as his was 8 inches long, while Hanley's length was only $5\frac{1}{6}$ inches. As Reeve's name was published first, the name is available for a shell living on the Queensland coast.

Winckworth regarded *assimilis* Reeve as a synonym of *pectinata* Linné, associating with it *hanleyi* Reeve and *serra* Reeve, even adding *lurida* Reeve and *chemnitzii* Reeve. The picture to which Linné referred alone (' Gualt. test.' t. 79, fig. A) for his *pectinata* recalls *hanleyi* Reeve from Amboyna, but *serra* Reeve from Moreton Bay is quite different. Hedley included both these under *inflata* Dillwyn, which, under the later name *inflata*

Wood, Winckworth allowed as a distinct species from *pectinata* Linné. As we have three distinct species of *Servatrina* living together in Queensland we can dismiss all the extra-limital names, *pectinata* Linné from India, *hanleyi* Reeve from Amboyna, *chemnitzii* Reeve and *lurida* Reeve from the Philippines, from further consideration.

Servatrina serra Reeve, 1858.

1858. *Pinna serra* Reeve, Conch. Icon. XI, pl. xxiii, fig. 43, June : Moreton Bay, Queensland.

This species is recognizable by its fine prickly sculpture, and this is seen in juveniles in a series sent from Keppel Bay by Mr. H. Bernhard. He sent three series, a smooth-ribbed form, *i. e. strangei* Reeve, the present species, and a coarsely prickly form = *assimilis* Reeve. Hedley admitted these three, but in this case referred *serra* and *hanleyi* Reeve to *inflata* Dillwyn, based on a figure by Chemnitz from the Nicobars. *P. hanleyi* is a smooth form, unlike *strangei* in shape, from Amboyna and is quite unlike the Queensland *serra*. Hedley also included *P. penna* Reeve from the Philippine Islands, a prickly shell closely resembling *serra*, but quite juvenile, and the adult may differ materially. Winckworth stated that the type-specimen of *penna* looks like a young *squamosissima*, and that the reputed locality, Philippines, is probably wrong, and it is an American shell. This proves the difficulty of dealing with illustrations in this group, and confirms the conclusion that specimens must be studied by local students. Prashad has revived *penna* for some very juvenile shells dredged in the East Indies, and Winckworth has now accepted this determination, but this is by no means definite yet, as juveniles are hard to fix.

Genus *Streptopinna*.

1880. *Streptopinna* Martens, Beitrag. Meeresf. Mauritius (Mobius), p. 318.
Haplotype : *Pinna saccata* Linné.

Shell contorted, dorsal line straight, ventral side convex, posterior extremity squarely truncate. Although the features of this shell appear abnormal, the animal must be more peculiar, as it lives among the coral blocks fixed by a byssus, with only a slight portion of the shell buried. While the shell has the plain ribbing of the Pinnoid series, this appears to develop later, the early portion of the shell being smooth. The muscle scars are small and quite unlike those of the true *Pinna* series, more like those of *Atrina*, but much smaller.

Streptopinna saccata inusitata Iredale.

1758. *Pinna saccata* Linné, Syst. Nat. 10th ed., p. 707, 1st January ; cites Rumph. Mus., t. 46, fig. N. Pinna alba ; Gualt. Test. t. 79, fig. F. " M. Medit. Indico."

The first citation must govern the type-locality of this Linnean species, and this must be Amboina. When it was found at Michaelmas Cay, and also Caloundra, the Queensland shell was separated by its different coloration, pale horn instead of amber-red, its more regular sculpture, five flattened distinctly separated ribs being counted, a sixth and seventh occurring in aged shells, and noticeable smooth area. It was named *S. saccata inusitata* (' Austr. Zool.' IV, p. 333, pl. xlvi, figs. 9, 10, 11. 18th May, 1927), and figured, the interior with the muscle scars being shown.

Suborder AVICULIFORMES.

This group includes the Pearl shells generally, the families Pteriidae, Reniellidae, Isognomontidae, all of which are genetically related.

Family Isognomontidae.

Better known as the family Pernidae, this family has been systematically neglected owing to the apparent variability of the species through their habit of living in crevices of rock or in mud among coral debris. It is almost impossible to determine species from figures, as only specimens from definite localities can be compared, and many species have been described from unknown locality. The irregularity of the species is, however, governed to some extent, so that we can distinguish genera, and five are here allowed, although probably more should be separated, the muscle scars varying, but the animals need study:

Large, elongate, animal large, extending along the shell, muscle scars separate, umbonal area broad and deep . . . . . . *Isognomon.*
Small, narrow, animal small, restricted to small nacreous area, muscle scars coalescing . . . . *Malleoperna.*
Very small, not elongated, small nacreous area, muscle scars not coalescing, umbonal area very shallow . . . . *Parviperna.*
Large, broad, hinge very broad, umbonal area very shallow . . *Melina.*
Small, very thin, hinge curiously crenulated . . . . . . *Crenatula.*

Genus *Isognomon.*

1786. *Isognomon* Solander, Cat. Portl. Mus. pp. 9, 41, 52, 115, 137, *ante* 8th April.
Tautotype: *I. lignea* = *Ostrea isognomum* Linné. Also spelt *Isognoma* (on pp. 9, 115, 137).
1789. *Perna* Bruguière, Ency. Meth., Vers, I, p. xiii.
Logotype: Anton, Verz. Conch. 1839, p. 17, "1838". *Ostrea isognomum* Linné.
Not *Perna* Retzius, Diss. Hist. Nat. Nov. Test. Gen., p. 23, 1788.
[1797. *Vulsella* Humphrey, Mus. Calonn. p. 44, *ante* 1st May.
Haplotype: *V. aurita* = *Ostrea isognomum* Linné.]
1798. *Isogonum* Bolten, Mus. Bolten, pt. II, p. 168, September.
Tautotype: *I. norma* = *Ostrea isognomum* Linné.
1815. *Pernaria* Rafinesque, Analyse Nat. p. 147.
New name for "*Perna* Brug." *Cf.* Iredale, Proc. Mal. Soc. (Lond.) IX, p. 262, 1911.
1817. *Pedalion* Dillwyn, Descr. Cat. Recent Shells, p. 282: in synonymy *ex* Solander MS.

This genus is formed of the very elongate pearl shells with the hinge line showing a series of ligamental pits, a byssal opening at the side, an extensive nacreous lining, and muscle scars separate; irregular in form, the exterior showing growth flaking, and the shell very thin at the edges, the sculpture being crude irregular radial ribbing.

Prashad (p. 81) has used *Isognomon* Solander, citing *Melina* Retzius in synonymy, but his remarks are not quite correct. He points out "there seems no justification for his [Iredale's] later suggestion that *Pedalion* (Solander) Huddesford should replace *Isognomon*". I did not suggest this. He added, "The genotype as selected by Iredale is *Isognomon isogonum* (sic) Linn.", with a footnote, "Iredale wrongly spells the specific name as *isognomon*, but the correct Linnean spelling is *isognomum*." I did not select a type, but

simply cited the type by tautonymy in Solander's spelling, which was *isognomon.* According to Prashad's references, Linné gives three different spellings in three different places, so that it might be difficult to determine the *correct* Linnean spelling, admitting that *isognomum* was used in 1758. If it be argued that the *first* spelling is always the correct one then Prashad should have used *Isognoma* Solander, as that is the *first* spelling given in the Portland Catalogue.

Isognomon isognomum Linné, 1758.

1758. *Ostrea isognomum* Linné, Syst Nat. 10th ed., p. 699, 1st January, based on first ref. Rumph., t. 47, fig. 1 = Amboina.
1786. *Isognoma lignea* Solander, Cat. Portl. Mus. p. 9, 8th April, new name for " *Ostrea isognomon* Linné ".
[1797. *Vulsella aurita* Humphrey, Mus. Calonn. p. 44, new name for *Ostrea isognomum* Linné.]
1798. *Isogonum norma* Bolten, Mus. Bolten, pt. II, p. 168, September, based on Chemn. 7, t. 59, fig. 582 : South Seas (Cook).
1798. *Isogonum gnomon* Bolten, Mus. Bolten, pt. II, p. 168, September, based on Chemn. 7, t. 59, figs. 583, 584 : Nicobars ; Ceylon and Moluccas.

Rumph's figure shows a dark-coloured shell with a fairly long anterior wing, such as Reeve figured ('Conch. Icon.' XI, Perna, pl. iv, sp. 19, March, 1858) as *P. patibulum* from unknown locality. Similar shells were collected at Low Isles.

Bolten gave two names to the shells figured by Chemnitz, thus : *norma* for fig. 582, *gnomon* for figs, 583, 584. From the figures it is suggested that *norma* was intended for figs. 582, 583, and *gnomon* for fig. 584 alone, as the two former are not winged, and the latter is anteriorly winged as in Rumph's figure.

Later Leach (' Zool. Misc.' II, pl. 114, 1815) distinguished the shell with the very small wing as *P. tranquebarensis* from Tranquebar, stating it was very distinct from the previously described species, and Lamarck (' Hist. Anim. s. Vert.' VI, pt. i, p. 140, July, 1819) renamed this as *P. femoralis,* citing the Chemnitzian figures 582, 583, regarding fig. 584 as representing the Linnean *isognomum.* Lamarck added (p. 141) *P. canina* from the Indian Ocean and New Holland, citing " Seba, Mus. 3, t. 91, f. 8 ", which agrees in shape with the shell named *P. fimbriata* by Reeve (' Conch. Icon.' XI, pl. iv, sp. 18, March, 1858) from the Moluccas.

This practically wingless form was also collected at Low Isles, and though at first sight the shells appear distinct, as most workers have acknowledged, there is no distinguishing feature yet available, and the only conclusion appears to be that the variation is due to environmental stress.

Nevertheless, geographical forms may later be separated, and Clessin (' Conch. Cab.' [Martini and Chemn.], ed. Kuster, VIII, Abth. i, p. 34, pl. x, fig. 2, 1890) has given the name *Perna novohollandiae* to a shell from New Holland ; in the same place he introduced *P. aquila, P. rollei, P. flava, P. obliqua* and *P. planulata* to more or less abnormal specimens from unknown localities.

Prashad (p. 82) has recorded *Isognomon isognomum* Linn., with a var. *canina* Lamarck, and a var. *norma* Röding. Of the typical form he cites no synonymic names, but of the var. *canina* he notes *fimbriata, patibulum* and *vespertilio* Reeve and *novohollandiae* and *? aquila* Clessin. As a synonym of var. *norma* he quotes *tranquebarensis* Leach, and *femoralis* Lamarck.

My own conclusions above noted were written up before I saw Prashad's account,

and it will be seen that there is much in agreement between them, which is very pleasing in such a perplexing molluscan form as here reviewed. I had examined the muscle scars, as these appeared to vary, but found that the variation, as far as could be ascertained with the material available, could not be utilized for differential purposes.

Into this complex there enter two or more other species, and these show variation that has been accepted in other cases, but the variation seen here has denied their recognition at present. These appear to have a distinct growth with a recognizable coloration, and may be of separate origin, but their true affinity is unknown. I refer to the species such as *attenuata* Reeve (' Conch. Icon.' XI, pl. vi, sp. 25, November, 1858 : Red Sea), and *lentiginosa* Reeve (' Conch. Icon.' XI, pl. vi, sp. 27, November, 1858 : Philippine Islands).

Some specimens appear to show radiately striate umbones, while others show concentric striation, but these have not been yet completely correlated in series.

Melvill and Standen (p. 184) recorded *Perna attenuata* Reeve from Torres Straits, but their specimens were probably the immature of the Australian form of *isognomum* Linné, especially as Reeve's locality was the Red Sea. At the same place they added *Perna lentiginosa* Reeve, a species described from the Philippine Islands, characterized by its tongue-shape, pale colouring and narrow base.

A similar shell is in this Museum from Port Darwin, North Australia, so it is possible that Melvill and Standen had such a form, but their records are peculiarly unreliable. On the other hand, Prashad (p. 84) has regarded *Isognomon attenuata* Reeve as valid, but with doubt, as he wrote, " appears to be a highly variable species. . . . It is probably only a form of *isognomum* ".

[*Isognomon perna* Linné, 1767.

1767. *Ostrea perna* Linné, Syst. Nat. 12th ed., p. 1149 : in Indiis.

Linné's description reads : " O. testa aequivalvi obovata inaequali ; hinc rotundiore cardine multoties sulcato. Habitat in Indiis. Testa facie Pernae, subdiaphana, colore ligni putridi s. ferruginea."

Hanley (' Ipsa Linn. Conch.' p. 117, 1855) stated that this recalled *Perna sulcata*, and gave a figure (pl. ii, fig. 7) of a shell from the Linnean cabinet. His doubt as to the determination is rather inexplicable until the word " aequivalvi " is considered, when it is remembered the species, *sulcata*, is rather notably inequivalve. Chemnitz (' Syst. Conch. Cab.' (Chemn.) VII, p. 249, 1784) drew attention to this when figuring a shell from Tranquebar (pl. lviii, fig. 577), which is of this form which Pfeiffer determined as *marsupium* Lam. Chemnitz's figure had, however, been named *Isogonum marsupiale* by Bolten (' Mus. Bolten ', pt. 2, p. 168, September, 1798). This appears to be the name for the " *perna* " auct.]

Isognomon australicum Reeve, 1858.

1858. *Perna anomioides* Reeve, Conch. Icon. XI, Perna, pl. iii, fig. 11, March : " California."
1858. *Perna australica* Reeve, Conch. Icon. XI, Perna, pl. iii, fig. 12 : Australia.

Prashad (p. 86) has written : " Reeve gives the habitat of *I. anomioides* as " California ", but on the type-tablet from the Cuming Collection in the British Museum (Nat. Hist.), London, the locality is given as Torres Straits." He then concluded : " Appears to be widely distributed in the Indo-Pacific Region and the Red Sea."

This name was used by Smith in determining specimens sent to him from this Museum years ago from Moreton Island and Port Essington. Hedley has since regarded such shells as *perna* Linné = *sulcata* Lamarck, following Hanley. Such shells were commonly sent from Lord Howe and Norfolk Islands, but are apparently uncommon in Queensland, the only localities represented being Caloundra and North-West Islet, Capricorn Group. Moluccan shells are more strongly sculptured than East Australian ones, and *sulcata* must be a similar shell. The Lord Howe Island shells are even smoother still, though ribbed, as they lack crenulations seen on the Caloundra shell.

Specimens were collected at Low Isles, and these have led to the reconsideration of the association. These species never elongate, the animal is restricted to a small area, and, on the whole, they appear to be more closely related to *Parviperna* than to *Isognomon.* The hinge has all its features very similar to those of the former, but the muscle scars differ, and the external sculpture is also unlike. It may later be shown by means of study of the juveniles and of the animals that there is even greater distinction, but in the meanwhile it seems best to introduce a subgeneric name *Anisoperna*, and name *Perna australica* Reeve as type. I am using Reeve's Australian name at present, as the figure of *anomioides* is more elongate than any of our specimens, and apparently the locality " Torres Straits " was merely written on the tablet from a superficial examination.

Genus *Parviperna* nov.

Type: *Parviperna perexigua* nov.

There has been so much confusion in connection with the small species belonging to this family that the only method of arriving at the truth is by working out the material available, without attempting to incorporate the unreliable records and imperfect data of the other workers. Apparently the first note of one of these small shells is that of Lamarck, who named *Perna nucleus* (' Hist. Anim. s. Vert.' VI (1), p. 142, July, 1819), with a length of 16 mm., and as " Habite à l'île S.-Pierre–S. François de la Nouvelle Hollande. Péron et Le Sueur ". The colour is not given, and the locality does not furnish such a shell as has been traditionally known under Lamarck's name. Then Gould (' Proc. Bost. Soc. Nat. Hist.' III, p. 312, December, 1850) introduced *Perna nana*, a little black shell from Fiji, and this has been regarded as Lamarck's species. Eight years later Reeve figured (' Conch. Icon.' XI, Perna, pl. i, fig. 4, November, 1858) a dull olive shell of unknown locality as representative of the Lamarckian form. At the same time he named *Perna lobata*, pl. i, sp. 1, *Perna pectinata*, pl. i, sp. 2, both small somewhat similar shells without locality, and some months before had issued *Perna quadrangularis*, pl. ii, sp. 6, March, a rather larger purple-black shell.

The small black species are here separated, and the Queensland form named as above.

The generic characters may be thus written : Shell very small for the family, regularly squarish ovate-oblong, not attenuately produced, byssiferous, practically equivalve, somewhat obese. Hinge line oblique, umbones terminal, the byssal opening below the apex. Cartilage pits four or five, large, the hinge area very pronounced. Muscular scars large and deeply impressed, the nacreous area practically covering the interior of the shell, marginal area very small in the genotype, though larger in other species but not longitudinally produced.

Parviperna perexigua sp. nov. (Plate V, figs. 1, 1*a*.)

1819. *Perna nucleus* Lamarck, Hist. Anim. s. Vert. VI (1), p. 142, July: Ile S. Pierre et S. François.

Lamy ('Bull. Mus. Nat. d'Hist. Nat. Paris', XII, 1906, p. 314) has cited as synonymous with Lamarck's species *Perna pectinata* Reeve ('Conch. Icon.' XI, pl. i, sp. 2, November, 1858), *Perna nucleus* Reeve (*ibid.*, sp. 3), *Perna quadrangularis* Reeve (*ibid.*, pl. ii, sp. 6, March, 1858); all described without any definite locality.

The two former are small yellow shells, the former looking like an immature shell, the latter less fimbriate and apparently older. *P. quadrangularis* is a black, not fimbriated, shell like the one here known as *nucleus*. Both yellow and black shells were collected on the beach rock at North-West Island, and looked like distinct species.

Shell very small, longer than broad, somewhat rectangular, hinge line oblique, anterior side practically straight, making a right angle, posterior side sinuate below acute umbo, then convex, ventral margin small and convex.

Coloration blackish, interior blackish purple, marginal edge very small and almost black.

The size of the figured specimen is 25 mm. in height, 16 mm. in breadth and 9 mm. in depth, and it was collected at Green Island, off Cairns, North Queensland.

As to the resemblance to *nana* Gould a series of shells was collected at Espiritu Santo, New Hebrides, by Mr. A. J. Marshall, and the smallest ones agreed with Gould's figure, but they developed with age a rather long brownish fimbriate extension, and thus became very unlike the Australian species. Topotypical shells from Fiji of Gould's *nana* agree.

Parviperna albisoror sp. nov. (Plate V, figs. 2, 2*a*.)

The small yellow shells, associated with the "*nucleus*" shells on the beachrock in crevices, differ in shape, growth and sculpture.

Shell very small, as broad as long, hinge line nearly straight, anterior side produced towards the ventral margin, posterior also a little produced ventrally, the byssal gape forming a shallow sinus, the ventral margin roundly convex. Coloration yellowish, sometimes with purple markings marginad. The nacreous area small, the margin large and produced all round, not lengthening ventrally. The hinge line nearly straight, six or seven cartilage pits being notable. Externally the shell is strongly flaked with growth, the left valve being more strongly ridged and a little more convex than the right, the umbonal area being faintly longitudinally rayed in the left valve.

The shell figured is from Low Isles and measures 27 mm. in height and 25 mm. in breadth, the depth being about 8 mm.

Genus *Malleoperna* nov.

Type: *M. intricata* sp. nov.

This genus is provided for the narrow elongate Pernoid forms which have been referred to as *Isognomon legumen* Reeve, and these shells resemble *Parimalleus* so much superficially that it is necessary to examine the hinge before determining them.

Shell elongate, narrow, thin, not winged, the nacreous area small, longer than broad, byssal gape lateral, shallow. The surface is very roughly flaked on both valves, which grow elongately somewhat irregularly and inclined to twist, the umbones smooth or with

concentric growth lines. The hinge is of the regular pattern of the family and the muscle scars coalesce.

Malleoperna intricata sp. nov. (Plate V, figs. 3, 3*a*.)

Some small elongate shells were collected at Low Isles which recalled Reeve's figure of *Perna legumen* (pl. v, fig. 22). Reeve's specimen was from Lord Hood's Island in the far Pacific, whereas Gmelin's name was based on a Nicobar shell. The specimens agreeing most closely with the original figures of Reeve, and Chemnitz, were taken out of holes in the nigger-heads from which the boring molluscs had been eliminated. The free-growing shell is here described: Shell small, elongate, yellowish, strongly flaked exteriorly. Coloration uniform cream, but rarely a purplish spot developing marginad. Interiorly the nacreous area is small, the ventral margin alone being elongately produced, somewhat irregularly. The hinge line is a little oblique, showing even closely set cartilage pits. The anterior side forms an obtuse angle with the hinge line and is produced rather obliquely; the posterior hinge angle is acute, the posterior side sinuate and obliquely produced irregularly.

The shell figured is from Low Isles and measures 30 mm. in length, 15 mm. in breadth and 8 mm. in depth.

The smaller, thinner, narrower hole-nestling shells appear different at first sight, but seem to be modifications of this species, and later may be investigated further.

A curious synonymic entry of *Isognomon legumen* Gmelin is given by Prashad (p. 87) thus: "1791. *Perna dactylus* Valenciennes, 'Encycloped. Method.' pl. clxxv, figs. 2, 3 ". There is no such name as *Perna dactylus* cited by Sherborn, the 'Encycl. Method.' plates did not bear scientific specific names, pl. clxxv was published (by Bruguière) in 1791, and Valenciennes was not born until 1794.

The real citation to *Perna dactylus* appears to be: "1824. *Perna dactylus* Bory de St. Vincent, 'Tabl. Ency. Method.', Vers, Coquilles, etc., I, p. 145, ex 'Val.' MS. for 'Ency. Method.' pl. 175, figs. 2, 3. No locality."

In this volume, following the 'Vers Intestines', pp. 84–133, there is an explanation of the plates which is signed by Bory de St.Vincent on p. 180. Therein the names of Gmelin, Lamarck and some MS. names of Valenciennes are allotted to the figures. In addition Bory named some of the figures himself, and these are marked with a large N. All the names given by Bory have been indexed by Sherborn, but the names accompanied by "Val." have been overlooked, as no one but a conchologist would recognize their novelty.

The figures upon which *Perna dactylus* are based appear to be copies of those of Chemnitz, the source of Gmelin's *legumen*, and this species is almost certainly living in holes, and Chemnitz's shell came from the Nicobar Islands. As noted above, Gmelin ('Syst. Nat.' VI, p. 3339, 1791) based his *Ostrea legumen* upon Chemnitz's account alone, and Chemnitz in 1784 was not using even a superficial binomial naming, and although the first two words in the phrase introducing this species happen to be "Siliqua spengleri", the species before was introduced by "Marsupium equitis Hungarici", and the one succeeding by "Concha semiaurita", although all were similar. Lynge (p. 146) revived Chemnitz's non-binomial name of *spengleri* for the shell known as *Perna legumen* auct., *ex* Gmelin, on account of his examination of the shell figured by Chemnitz ('Conch. Cab.' VII, pl. 59, fig. 578). As Chemnitz was non-binomial this revival does not concern our

usage, but our shells may differ from the free living ones as they are smaller, smoother, more regular in growth, all of which may be due to their environment, but as they are notably recognizable they may be named ecologically thus: *Malleoperna* (*intricata*) *debilitata* ecomorph nov. It has been noted many times in the consideration of the Low Isles mollusca that there are series of shells which are formed from restricted ecological conditions and which reappear throughout the range of the species when similar environmental stresses coincide. These can scarcely be regarded as species in the sense commonly used, nor are they, strictly speaking, geographical subspecies, so they may be recognized as ecomorphs, indicating their origin.

Malleoperna paucidentata sp. nov. (Plate V, figs. 4, 4*a*.)

A long thin shell, recalling the "*legumen*" species, differed at sight in lacking the irregular flaky growth. Inside the hinge differed in having a few distant teeth instead of the many close teeth of the so-called "*legumen*" of Australia, and it may be more closely related to *Isognomon*. Shell very long and narrow, small, hinge line with few teeth, surface not strongly flaked. Coloration uniformly cream, with faint purple spotting at its extremities.

Hinge line narrow, with four to five ligamental pits, the umbonal area deeper than in the preceding. The byssal sinus shallow, the nacreous area not definitely separated off from the lengthened portion, thus tending to remove it further away from *M. intricata* and nearer to *I. isognomum*. The shell from Low Isles measures 48 mm. in length, 19 mm. in breadth and 9 mm. in depth.

Genus *Melina*.

1788. *Melina* Retzius, Diss. Hist. Nat. Nov. Test. Gen. p. 22.
Logotype : Gray, Proc. Zool. Soc. (Lond.) 1847, p. 200, November. *Ostrea ephippium*.
1811. *Sutura* Megerle, Gesell. Nat. Freunde Berl. Mag. V, p. 65.
Logotype : Gray, Proc. Zool. Soc. (Lond.) 1847, p. 200, November. *Ostrea ephippium*.
[1770. *Pedalion* Huddesford, Conchol. (Lister), Index, p. 23, *ex* Solander MS. Non-binomial usage.]

These shells are very different in appearance from *Isognomon*, and must cover a very different form of animal.

Shell large, subcircular in general aspect, but with the hinge cramped, and lengthened out of the circular form. The hinge is comparatively long, with many teeth, the sinus long and shallow, the shell expanding below laterally and never narrowing. Consequently the body-area is very large, filling all the extent, with only a small border around. The umbonal area is deep and the muscle scars coalesce. The shell is very thin, with a fine flaky surface, but with old age it becomes rather solid, but even then the edges are translucent.

Melina ephippium Linné, 1758.

1758. *Ostrea ephippium* Linné, Syst. Nat. 10th ed., p. 700 (1st January), based on Rumph. mus. 47, fig. B : O. Asiatico.
1798. *Isogonum scapula* Bolten, Mus. Bolten, II, p. 168, September, on Chemn. 7, t. 59, fig. 576, and Knorr, 6, t. 21, fig. 1.
1858. *Perna cumingii* Reeve, Conch. Icon. XI, pl. i, sp. and fig. 3, November : Australia.
[Not *Perna ephippium* Reeve, Conch. Icon. XI, pl. ii, sp. and fig. 8, March, 1858 : Honduras.]

Hedley listed *Melina cumingii* Reeve from Queensland, and Shirley added *Perna ephippium* Linné from Torres Straits, perhaps from a British Museum identification. The

introduction of *cumingii* Reeve for an Australian shell was due to Reeve's transference of *ephippium* to a West Indian species ; but Linné's species was indubitably the oriental form as shown by the locality and citation and acknowledged by Hanley.

Lynge (p. 417) recorded *Perna cumingii* Reeve from the Gulf of Siam, and noted that the West Indian *alata* Gmelin bore much resemblance. Then naïvely inquired, " But what is to become of *P. ephippium* L., if these two species be maintained ? " Obviously it was one of the two later names that must suffer, because the original Linnean name must be preserved.

Melina periculosa sp. nov. (Plate V, figs. 5, 5*a*.)

This seems to be the reef representative of *M. ephippium* in Queensland, and it is immediately separated by the anterior wing, with the body expansion in that direction exactly contrary to the form of *M. ephippium.*

Shell of medium size, thin, brittle, flattened, hinge line long, posterior side showing byssal sinus, but no expansion posteriorly, while the anterior side is winged, deeply sinuate and expanded, but never narrowed ; ventral margin roundly convex. Sculpture of obscure radials unevenly distributed, more marked anteriorly, growth flaking present but obscure. Coloration deep purplish red, the earlier portion showing purple radials on a yellowish ground. Internally the body nacre extends to the small black marginal edge and varies from purple to bluish white.

The hinge line is very long, with the cartilage pits few in number and widely spaced.

The figured shell from Low Isles measures 56 mm. along the hinge line, with about 50 mm. across the body, and 52 mm. in height, the depth being about 8 mm.

Genus *Crenatula.*

1803. *Crenatula* Lamarck, Ann. Mus. Nat. Hist. Paris, III, p. 28, December.
Logotype : " Children ", Quarterly Journal Science, XV, p. 34, 1823, *Crenatula avicularis* Lamarck.

This genus was introduced with three species : *C. mytiloides* from the Red Sea, *C. avicularis* from the Antilles, and *C. phasianoptera* for *Ostrea picta* Gmel., based on 'Chemn. Conch.' VII, p. 243, t. 38, fig. 575, from the Red Sea, which Lamarck states he had not seen. The shells are very thin, a little irregular in shape through living in sponges, hinge line long and straight, with a few close ligament pits with curved bases forming a crenulated hinge area (hence the generic name). There is a great tendency to oblique growth, the valves being convex, the left being more convex, while internally the body-area, circumscribed by a nacreous patch, is very small.

This is an excellent instance of the futility of accepting " Children's " type designations, as he writes : " The type is *modiolaris*, Lamarck's second species. Lamarck's type is *C. avicularis.*" Obviously the word "type" means "first species" only, and Children was unlucky here as *modiolaris* does not occur in the first introduction of *Crenatula*, as above, and therefore cannot be the type at all.

Crenatula modiolaris Lamarck, 1819.

1819. *Crenatula modiolaris* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 137, July : Maria Island, New Holland, error = Shark's Bay, West Australia.

Hedley included in the Queensland list *Crenatula flammea* Reeve, but that species was localized (' Conch. Icon.' XI, pl. ii, sp. 5, November, 1858) as from New Caledonia, and it seems to be a variant of Lamarck's species. A specimen was secured at Station XIX, and perhaps Reeve's name may be used subspecifically, but the specimens are so frail, and their habit of living in sponges usually entails breakage. This species was in Lamarck's cabinet, and was therefore beautifully figured by Delessert (' Recueil Coq. descr. Lamarck', pl. xiv, figs. 2, 2*b*, 1841).

Crenatula nigrina Lamarck, 1819.

1819. *Crenatula nigrina* Lamarck, Hist. Anim. s. Vert. VI, pt. i, p. 137, July : "Les mers de l'Asie australe, Péron" = Shark's Bay, West Australia.

The locality cited, with Péron as collector, was due to the unfortunate death of the collector and the mishandling of the specimens, each one of which was correctly described and labelled at the time of capture by that indefatigable naturalist. At the place quoted Lamarck described four species, *C. modiolaris*, *C. nigrina*, *C. bicostalis* and *C. viridis*, the last-named of which has since been recognized from North-West Australia.

Smith (' Rep. Zool. Coll. "Alert", p. 113, 1884) recorded *C. nigrina* Lamarck as of Reeve, from Albany Island, observing : "This species, also *C. bicostalis* and *C. mytiloides*, as determined by Reeve, are probably slight variations of one and the same form."

Family Pteriidae.

This family includes the Pearl Shells proper, a series of rather flattened, subcircular shells of varying sizes, some of which have the posterior end of the hinge abnormally lengthened into a beak or wing. All are very perlaceous inside and of thin texture (save when they grow to a very abnormal size), with a weak, almost toothless hinge and external median ligament.

Four divisions are here utilized :

Shell large to small, with long to very long wing always broader than high *Austropteria*.
Shell very large, medium wing, higher than broad . . . . . *Magnavicula*.
Shell medium to large, wing obsolete, never broader than high . . *Pinctada*.
Shell small to very small, smooth, no wing, or only slightly defined . *Electroma*.

Genus *Austropteria*.

1931. *Austropteria* Iredale, Rec. Austr. Mus. XVIII, p. 205, 29th June.
Orthotype : *A. saltata* Iredale.

This name was introduced for an Australian winged pearl shell and is here used to include all the local species with the long wings, although, as mentioned below, the bodies are of different form.

Shell of medium size with a long hinge, small ear, more or less posterior wing, the exterior covered with a fine dense periostracum, internally nacreous.

The hinge is weak, with a median ligament, the teeth on each side being small and delicate. Byssal gape small. Muscle scars separate.

In the type-species the body cavity is large and the nacre extends to a small border, the left valve is convex deeply, while the right valve is convex and then concave, fitting inside. Also in this valve the nacre is of less extent and there is a wide margin posteriorly. In some of the smaller species the teeth are stronger and the convexity less, while in others the convexity is seen in both valves almost equally and the teeth may be stronger.

Under the generic name *Pteria*, Hedley included in the Queensland list the following species: *P. ala-corvi* Chemnitz, *P. aquatilis* Reeve, *P. crocea* Chemnitz, *P. lata* Gray, *P. macroptera* Lamarck, *P. malleoides* Reeve, *P. muricata* Reeve, *P. rufa* Dunker, *P. smaragdina* Reeve and *P. zebra* Reeve. As if this list of names were not large enough, Shirley added *P. marmorata* Reeve from Yeppoon, and Banfield, on Hedley's determination, recorded *P. peasei* Dunker from Dunk Island, in ' Tropic Days '. At first sight *lata* Gray and *rufa* Dunker refer to the same species, and *smaragdina* Reeve appears to indicate the same shell in Queensland as *ala-corvi* Chemnitz. *P. muricata* Reeve is an erroneous generic location, the Reevean species being a *Pinctada*. There are, however, many species living in Queensland waters, but they are apparently all of restricted distribution. In order to ascertain the species correctly the variation in shape owing to growth must be studied, and the development of the wing appears to be a characteristic feature.

Odd small specimens were secured at Low Isles, but Mr. Melbourne Ward dredged a number at Lindeman Island, and previously had procured some from the Albany Passage, and, with Mr. W. Boardman, had dredged a few at Port Curtis. They mainly live affixed to the branches of Alcyonarians, and sometimes two or three species will be found on the same Alcyonarian, even touching each other. The byssus is fairly strong and the shells are fragile.

Four different series can be recognized in these forms after eliminating *Electroma*, but these are difficult to diagnose; thus, *Austropteria* s. str. is a medium-sized shell with a small ear, a short thickish beak or wing, and a large rounded body; there is no angulation posteriorly, and the posterior depression is faint; the sinus is shallow and the hinge teeth weak. Then there is the large " *macroptera* ", a large shell with a fairly large ear, a long thin beak, a large rounded body with rounded posterior shouldering, and a deep posterior depression; the sinus is deep, and the hinge teeth comparatively weak. Then there are the long-beaked forms with small bodies which separate into two, one with a large ear and an almost vertical body, and the other with a small ear and body more parallel to the dorsal; these are easily distinguished, and Reeve's figures, 56 and 57, show the difference in form well.

The species may be distinguished:

Large, medium wing, thin periostracum, body very large and rounded, hinge teeth small and delicate . . . . *saltata.*

Small to large, wing long, fine periostracum, body large and elongate, hinge teeth small but strong . . . . *perscitula.*

Shell medium, wing long, periostracum very slight, body large, long, and very oblique, ear small, and concavity of right valve . . . *antelata.*

Small to medium, wing long, body long and shallow, periostracum thin, both valves flattened, little convex . . . . . . *levitata.*

Shell small, wing long, body long, periostracum thick, both valves convex, ear long and narrow . . . . *calosoma.*
Shell small, wing short, periostracum very fine, body large and deep, left valve swollen, right valve flattened . . . . . . *bernhardi.*
Shell large, wing short, body large and deep, surface strongly flaky, periostracum obsolete, ear small, hinge teeth strong . . . *macculochi.*
Shell very small, wing medium, body large, thin periostracum, ear long and narrow . . . . *maura.*

Austropteria saltata Iredale, 1931.

1931. *Austropteria saltata* Iredale, Rec. Austr. Mus. XVIII, p. 205, 29th June : South Queensland. Not *Avicula reticulata* Phillips, 1841, *fide* C. D. Sherborn.
1857. *Avicula reticulata* Reeve, Conch. Icon. X, pl. xviii, sp. 74, fig. 70, March : Australia.

This is *Pteria lata* Gray, of Hedley's list, and also *Pteria rufa* Dunker of the same list. The former was named from the north and western coasts of Australia, and, as figured by Reeve from Port Essington, is a much deeper shell. The latter was described from Java, and the figure shows a deep shell, like the true *lata*. At the same place Dunker (' Zeitschr. für Malak.' 1848, p. 178, April, 1849) introduced *Avicula serrulata* for a Moluccan shell, and this has been synonymized with *lata*, although obviously it would be more like *rufa*, and has page precedence. In a series dredged at Port Curtis, Queensland, in about 9 fathoms, by Messrs. Mel. Ward and W. Boardman, the young stages have the wing well differentiated, but with age it becomes obsolete. Another series dredged since by Mr. Melbourne Ward at Lindeman Island in from 7–10 fathoms have, however, the wing well developed, and differ from the West Australian species in also having the anterior ear smaller.

Austropteria perscitula sp. nov. (Plate V, figs. 6, 6*a*.)

E. J. Banfield, in his ' Tropic Days ', published in 1918, used the name *Pteria peasei* for a winged pearl oyster on p. 107 ; this name had been communicated to him by Mr. Charles Hedley, to whom he had sent a specimen. The specimen, which is here figured, does not agree with Banfield's photograph, which suggests a different species. Neither agrees with Dunker's figure (' Conch. Cab.' [Martini and Chemnitz], ed. Kuster, VII, abth. 3, p. 24, pl. viii, fig. 1, 1872) of *P. peasei*, a name he introduced to replace *Avicula radiata* Pease, from the Kingsmill Island, Pease's name being invalid.

The shell is small, the wing long and narrow, the posterior depression deep, the posterior angle blunt but elevated, sloping rather steeply marginad and anteriorly. This relates to the left valve, as the right valve is much less convex, the depression shallower, but is only slightly clasped, the byssal sinus large. The ear is comparatively large, and the whole shell is covered with a short dense periostracum of radial concentric scallopings. The shell coloration is dark green outside, blackish-purple nacre inside, the edges blackish green. The hinge teeth are rather large and well marked for this genus, and there is a posterior wing-groove. The figured specimen, which measures 59 mm. along the dorsal edge, 25 mm. in height and 10 mm. in depth, came from Dunk Island.

As these pages were being checked over for the last time I received from Mr. H. Bernhard a specimen for determination from Keppel Bay. Along the dorsal edge it

measures 185 mm., with a height of 80 mm. It is dead and shows the early part of the shell to have been dark green, which becomes paler with age, and remains longest on the posterior angulation. In the concavity of the posterior area remnants of the periostracum remain which show it as having been composed of radial rows of concentric minute scallops. It agrees in detail with the small shell here figured and named *perscitula*.

Austropteria antelata sp. nov. (Plate V, fig. 7.)

Hedley and McCulloch collected a very beautiful shell at Murray Island, Torres Straits, which is obviously not conspecific with the preceding, although it is a long-winged form. It differs in its smaller ear, more elongate body, shorter, broader wing, and especially by the form of the right valve, which is convex at first, and then becomes concave, to be clasped tightly by the left valve, though it does not decrease in size. In coloration it is strikingly different, having practically no periostracal covering, and being dull deep red, rayed with bold black radials. It measures 72 mm. along the dorsal margin, and is 35 mm. in height and 12·5 mm. in depth.

Austropteria bernhardi sp. nov. (Plate V, figs. 8, 8*a*.)

This small, rather smooth shell from Albany Passage appears to grow into a large shell, which has been called *marmorata* by Shirley, but which is not much like Reeve's *marmorata*. The figured shell is small and thin, small elongate ear, short wing with body reaching almost as far, and rounded, but not too deep comparatively, the posterior area flattened, but scarcely depressed, the convex left valve sloping to it without angulation the right valve is little convex, mostly flattened. The shell is pale creamy with reddish radial rays, a very fine periostracum showing marginad and on the ears.

This specimen measures 40 mm. along the dorsal margin and 17 mm. in height, the depth being 9 mm.

Shells reaching 70 mm. in length, from Keppel Bay, are of the same general shape, have well-marked dark brown-red rays and a fine dense periostracum.

Austropteria calosoma sp. nov. (Plate V, fig. 11.)

A beautiful little shell was dredged at Station XII, which is quite unlike any other It has small elongate ears, medium wing, rounded body, with a narrow ditch between the body and the wing. Both valves are convex, the left very little more than the right. There is a periostracal covering which develops radials of longer triangular flakes on both valves. The shell is pale creamy, with strong radial colour rays of purple, and the periostracal radials appear to agree with these colour rays. It is apparently very like *Avicula scabriuscula* Reeve ('Conch. Icon.' X, pl. xiv, sp. 54, March, 1857), which was localized as "Australia", but is differently coloured and has a much shorter wing. It is possible that Reeve's species came from Western Australia, but as form and coloration have been found to be constant, it is imperative to name the Low Isles shell, which measures 42 mm. along the dorsal margin, 18 mm. in height and 9 mm. in depth.

Austropteria levitata sp. nov. (Plate V, fig. 12.)

Shell small, medium beak, not very convex, body rounded, ears small, elongate, unicolour brown red with little periostracum. The left valve is not very convex, while the right is scarcely convex umbonad, and definitely concave marginad.

This shell was living on a piece of Alcyonarian, along with specimens of *A. saltata*, and it differed at sight in its lengthened wing, its smoothness and its shallowness, though its coloration was similar. The convexity of the left valve slopes gradually to the flattened beak with scarcely any depression, and the wing is not distinctly separated. The periostracum is very fine, and umbonad the shell is quite smooth, the periostracum coarsest on the ears. The specimen measures 58 mm. along the dorsal margin, 20 mm. in height and 6 mm. in depth, and was dredged at Port Curtis.

Austropteria maccullochi sp. nov. (Plate V, figs. 9, 9*a*.)

Reeve figured, under the name "*Avicula atlantica* Lamarck", a shell collected in Australia by Jukes. He stated ('Conch. Icon.' X, pl. xviii, sp. 73, fig. 69, June, 1857): "This species has doubtless a wide range of habitation", but there is a shell on the east coast of Australia answering fairly to Reeve's figure, so that the locality may be correct. This revives the determination of the shell described by Lamarck ('Hist. Anim. s. Vert.' VI (1), p. 148, July, 1819) from the "Mers de la Nouvelle-Hollande, Péron" under the name *Avicula falcata*, and which Deshayes regarded as the same as *Avicula tarentina* Lam. from the Mediterranean Sea. Most of the tropical shells described by Lamarck from Péron's collecting came from Shark's Bay, West Australia.

The shell here figured was taken from the Jenny Lind Buoy, Port Curtis, by the late A. R. McCulloch, with the note that the buoy had only been in the water twelve months. It is large, rather square, solid, short winged, round bodied, wing flattened, body convex, posterior depression, the right similar but with less convexity. The shell is quite unlike any other in form, but more so in texture, which is solid, and the exterior does not show a periostracum, but is very strongly irregularly flaked throughout on both valves. The coloration of it is darkish brown towards the umbones, but the flaking is of a pale brown, and covers the whole shell; inside the nacreous portion is fairly large, but there is a broad golden-brown margin, wider on the right valve. The hinge is powerful, the teeth being well developed. The byssal sinus is large, and the valves appear to be gaping—a somewhat unexpected occurrence. The shell measures 85 mm. along the dorsal margin, 64 mm. in height, and 33 mm. in depth.

Austropteria maura Reeve, 1857.

1857. *Avicula maura* Reeve, Conch. Icon. X, pl. xvii, sp. and fig. 72, June: Sydney.

This very small species has been recognized from Port Curtis, and there are apparently more small species to be described.

Genus *Magnavicula* nov.

Type: *M. bennetti* sp. nov.

This generic name is proposed for the large species, which have been misnamed "*macroptera*" Lamarck. The Queensland shell is elongate with a narrow long wing,

the left valve very convex, the right valve less convex, ear large, byssal gape small and deep, posterior depression marked, hinge line long, teeth small.

Magnavicula bennetti sp. nov.

Hedley admitted *Pteria macroptera* Lamarck to his Queensland list, but the name is under a cloud, both zoologically and nomenclatorially. The Queensland specimens differ from the illustrations cited by Lamarck, and at the same time Lamarck named *A. lotorium* based on ‘ Chemn.’ VIII, t. 81, fig. 728. The latter has been commonly regarded as a variant only of the first-named, and if this were so, the name would become *penguin* of Bolten, who based his *Pinctada penguin* (p. 167) upon the same Chemnitzian figure. This figure looks very different from our shells, and agrees with specimens from the Persian Gulf in shape and size. Since this was written I find that Prashad (p. 93) has used “ *Pteria penguin* (Röding)” for “*macroptera* Lam. and *lotorium* Lamarck”, explaining, “ It is unfortunate that the Lamarckian name of this well-known species has to be replaced to [= by] the earlier one of Röding, but there can be no doubt that the Lamarckian name is synonymous with the earlier one of Röding. I have also no doubt that Lamarck’s second species, *A. lotorium,* is based on only slightly different shells of this widespread species ”. The facts are as given above, *penguin* displacing *lotorium* exactly, and *macroptera* is available validly for the “ slightly different ” form.

The shells under notice were scraped off the “Hankow”, a coal hulk moored at Thursday Island in September, 1923, and which had been cleaned previously. They were collected by Commander Bennett in October, 1927. Measurements read : Along the dorsal margin, 160 mm. ; height, 125 mm. ; depth, 40 mm.

Genus *Electroma.*

1871. *Electroma* Stoliczka, Pal. Indica, III, p. 391, 1st March.
Haplotype : *Avicula smaragdina* Reeve.
1872. *Electrina* Martens, Zool. Record, 1871, p. 171, error only.
Not *Electrina* Baird, Nom. Moll. Coll. B.M. (1), p. 30, 1850.

Stoliczka wrote : “ Oblique, thin, mostly smooth . . . closely resemble true *Aviculae,* but are more inequivalve, the right valve being somewhat flatter, the hinge line is short, and the posterior wing very short, not separated from the body of the shell.”

This agrees well with the shells about *smaragdina,* but generally the right valve is only convex umbonally and concave marginad, where it is more or less clasped by the left ; the anterior ears are short, the byssal gape rather large and the byssus strong.

A similar form of shell, but smaller and thinner, has a definite posterior wing separated from the body of the shell and therefore does not agree, but it is here separated only as a subgenus with the name *Pterelectroma,* the type being the species *Avicula zebra* Reeve.

Electroma tragulata sp. nov. (Plate V, figs. 10, 10*a*, 13.)

At Station XVII four specimens of *Electroma* were found attached to pieces of coral, and the two figured were on the same branch attingent. One was dark unicolor and the other was pale green, rayed with darker, and clouded with opaque white dots. The

shape is so different that there seemed doubt as to their specific identity, as both were growing freely. However, the other two were of the form of the dark one, with the coloration of the light one. Reeve figures a similar variation in coloration in the case of *P. ala-corvi* from the Red Sea.

The shells are small, smooth, with no notable periostracal covering, hinge-line short, toothless, left valve convex, right valve convex umbonad but concave marginad, where it is clasped by the left. The anterior margin gently curves backward from the dorsal margin, forming a rounded ventral margin, and then a posterior margin either convex or concave. The dark shell measures 27 mm. in length, the dorsal margin 13 mm., height 16 mm. and depth 6 mm.; the pale shell is rather longer, about 31 mm.

Electroma pygmea sp. nov. (Plate V, fig. 17.)

Under stones about half-tide at Port Douglas I found a few specimens of a very small, yet apparently adult shell measuring 8 mm. in length, 5 mm. in height and 2 mm. in depth. The shell is very small, thin, oblique, pale green mottled with darker and characterized by a series of marked growth lines; the shell is flattened, the left valve slightly convex, the right faintly convex umbonad, concave and clasped marginad.

Electroma zebra Reeve, 1857.

1857. *Avicula zebra* Reeve, Conch. Icon. X, pl. xi, sp. 36, March: Moreton Bay, Queensland.

This well-known shell has been figured by Odhner ('Kungl. Svenska Vetensk. Handl.' LII, No. 16, pl. i, figs. 6–8, 1917) from West Australia, so that two Lamarckian names deserve investigation, viz. *Avicula physoides* ('Hist. Anim. s. Vert.' VI (1), July, 1819, p. 149) and *A. virens* (*loc. cit.*, p. 150).

Specimens have been commonly dredged in Port Curtis, 8–10 fathoms, Lindeman Island, 9–10 fathoms, and the Expedition secured three small specimens attached as usual to *Plumularia* at Station XIX.

Genus *Pinctada*.

1798. *Pinctada* Bolten, Mus. Bolten, pt. II, p. 166, September.
Logotype: Iredale, Proc. Mal. Soc. (Lond.) XI, p. 305, 1915, *P. margaritifera* = *M. margaritiferus* Linné.
1811. *Margaritiphora* Megerle, Ges. Nat. Freunde Berl. Mag. V, p. 66.
Haplotype: *M. communis* Megerle.
1814. *Margarita* Leach, Zool. Miscell. I, p. 107.
Haplotype: *M. sinensis* Leach.
1817. *Perlamater* Schumacher, Essai Nouv. Syst. Test. pp. 38, 107.
Tautotype: *P. vulgaris* Schumacher.
1819. *Meleagrina* Lamarck, Hist. Anim. s. Vert. VI (1), p. 150, July.
Haplotype: *M. margaritifera* Lamarck.
1826. *Pintadina* Blainville, Dict. Sci. Nat. (Levrault), XLI, p. 93, Sept. 23, *ex* Lamarck MS.
Haplotype: *Mytilus margaritiferus* Linné.
1901. *Margaritifera* Jameson, Proc. Zool. Soc. (Lond.) p. 372, Aug. 1, *ex* P. Browne, 1756, pre-Linnean.
[1797. *Margaritifera* Humphrey, Mus. Calonn, p. 44, May.
Haplotype: *Mytilus hirundo* Linné.]

Thirty years ago Jameson ('Proc. Zool. Soc. (Lond).' 1901, pp. 372 *et seq.*) reviewed the Pearl Oysters, using the British Museum collection as a basis. Unacquainted with

taxonomic usage, and ignorant of systematic work, his conclusions need severe emendation. Thus, he concluded that *Pteria* Scopoli 1777 should be the generic name, and then utilized *Margaritifera* P. Browne 1756, a pre-Linnean non-binomial earlier name, as subgeneric for the true Pearl Oysters. He then recorded the species under the latter name, using it generically, and divided the genus into two groups as follows :

Division I : Hinge without teeth.
II : Hinge with teeth.

To the former group *Pinctada* would apply, and for the latter series *Perlamater* Schumacher would be available. To the former division he only allots *margaritifera* Linné with many varieties, and *maxima* Jameson. All the rest of the many species come under the second division, which he divides again into sections according to the prominence of the hinge teeth :

Shell very large, light coloured, ligament comparatively small, hinge teeth obsolete, but indicated in small shells, few scales . . *maxima.*
Shell large, dark coloured, ligament large, hinge teeth missing, not even noticeable in small shells, scales few . . . . *nigromarginata.*
Shell small, convex, ligament long, teeth small, thin, coloration whitish blotched with purple, scaly marginad . . . . . . *panasesae.*
Shell medium, flattened, smooth, few scales marginad, ears small, shell semi-winged . . . . *epitheca.*
Shell small, flattened, smooth, subcircular, ears small, coloration bronze red, ligament large, teeth small . . . . *perrutila.*
Shell medium, flattened, smooth, higher than broad, ears small, coloration white and purple . . . . *placunoides.*
Shell medium, flattened, rough, regular, ears small, yellowish and red rays scaly close sculpture . . . . *irradians.*
Shell medium, very rough, oblique, ears very small, scales strong and coarse, coloration yellowish brown . . . . *reeveana.*
Shell medium, very rough, regular, ears small, yellowish coloration, scales most marginad . . . . *sugillata.*
Shell medium, very rough, regular, small ears, yellowish coloration very long spines . . . . *lacunata.*
Shell medium, very rough, regular, small ears, dark bronze coloration, short scales . . . . *aerata.*
Shell medium, subcircular, smooth, ears small, coloration pale greenish rayed with darker green . . . . *perviridis.*

Inasmuch as many of the above have been regarded as synonyms, it may be stated that most of these have been found living alongside, each showing the specific characters clearly. The most recent instance may be cited as an example. Mr. G. P. Whitley collected a series of shells in Edgecumbe Bay, near Bowen, without any attempt at selection, and these provided five different species : *epitheca, placunoides, reeveana, sugillata* and a *perviridis*-like shell. On Low Isles were found *maxima, nigromarginata, panasesae, perrutila, placunoides* and *perviridis.*

Pinctada maxima Jameson, 1901.

1901. *Margaritifera maxima* Jameson, Proc. Zool. Soc. (Lond.) 1901, p. 397 (1st August): Moresby Island, British New Guinea.

Juvenile specimens were met with at Low Isles which are ascribed to the gigantic Golden-Lip, the commercial mother-of-pearl shell of Torres Straits. One of the largest known specimens from Torres Straits in this Museum measures 282 mm. in length, with a width of 250 mm., the thickness of the shell being abnormal, and the weight of the pair of valves being 9 lb. 9 oz.

Pinctada nigromarginata S.-Kent, 1893.

1893. *Meleagrina nigromarginata* Saville-Kent, Great Barrier Reef, p. 215 (pref. 24th February): Thursday Island, Torres Straits.

Hedley included in the Queensland list *Meleagrina margaritifera* Linné, but Jameson had reported that examination of Linné's type suggested that the right valve was an East Indian shell, probably from the Malay Archipelago, but that the left valve was a Red Sea specimen. He then used Linné's name for the Malayan species, observing that Australian shells did not show much difference, but that they were distinguished by the buyers and sellers of mother-of-pearl.

Jameson included as a distinct species *M. flexuosa* Reeve (' Conch. Icon.' X, pl. iv, sp. 4, March, 1857 : Cape Hillsborough, North Queensland) without comment, but it may represent the shore form of the Linnean species. Hedley admitted it to the Queensland list on account of its type-locality, and the fact that Jameson did not discuss nor dismiss it. The Australian coral-reef shells are comparatively small and differ in shape from the typical *margaritifera*, being longer than broad, with the anterior margin scarcely projecting, a line perpendicular to the hinge at its anterior end cutting off very little of the nacreous area, whereas Jameson utilized this feature, stating it cut off " a considerable area ($\frac{1}{5}$ total antero-post. measurement) ". In any case *flexuosa* is invalid.

A gigantic pair has been lately received in this Museum from the Pacific Islands, and these almost exceed the huge *maxima* just previously noted. The length of the valve is 270 mm.—a little shorter—but the breadth is 274 mm.—a deal broader. The length of the pearly nacre is about the same in the two shells, but this is very much thinner and the pair only weighs 6 lb.

[*Pinctada vulgaris* Schumacher, 1817.

1817. *Perlamater vulgaris* Schumacher, Essai Nouv. Syst. Test. p. 108, pl. xx, fig. 3, for Chemn. 8, p. 126, tab. 80, fig. 717.

All small and immature Pearl Shells have been called *vulgaris* Schumacher, and Lynge has written (p. 143) : *P. vulgaris* Schum. is identical with *P. picata* Gld. *P. vulgaris* Schum. has had numerous names given to it owing to its variability in shape and colour."

Jameson, however, had admitted *P. vulgaris* Schum. as a distinct species, and had allowed *pica* Gould (not *picata*) also specific value, renaming it *panasesae*, as Gould's two selections had proved invalid.

The figure of the hinge given by Schumacher (pl. xx, fig. 3) shows a small rostrum and a posterior sinuation, whereas Chemnitz's figure shows a large rostrum and no posterior sinuation. Chemnitz included all the common Pearl Mussels of the West Indies and East Indies in his account, but mentioned that the East Indian ones were larger, thicker, etc., suggesting that the West Indian species be regarded as typical. The internal figure only agrees in form with that of the West Indian Pearl Oyster, known as *Pinctada radiata* Leach, *fide* Jameson, and as Leach's name dates from 1814, Schumacher's name can be dismissed as a synonym.

Prashad (p. 99) includes *Pinctada vulgaris* (Schumacher), citing as synonyms *Meleagrina albina* Lamarck, *Avicula fucata* Gould, *A. badia* Dunker, *Margaritifera imbricata* Mörch, *Avicula perviridis* Reeve, *A. occa* Reeve, *A. aerata* Reeve and other Red Sea and Mediterranean determinations. As noted above, *vulgaris* Schumacher can be rejected as based on a West Indian shell. Then Lamarck's *M. albina* is probably founded on a Shark's Bay shell, the species we now call *carchariarum* Jameson, if it really came from Australia. The var. with the violet tinge may be more like the *vulgaris* here at issue. *A. fucata* Gould, from Japan, can be easily eliminated from this medley, as it has little in common with the spurious " *vulgaris* ". *A. badia* Dunker is nothing like, judging from the figure, and I don't know what was intended by *M. imbricata* Mörch, Bolten's *imbricata* being quite distinct. *A. perviridis* Reeve has been suggested by me as the southern form, having been collected by Strange in Australia, but *A. occa* Reeve from the Red Sea is certainly not the same. *A. aerata* Reeve appears to be a valid species from Australia.]

Pinctada panasesae Jameson, 1901.

1901. *Margaritifera panasesae* Jameson, Proc. Zool. Soc. (Lond.) 1901, p. 390, fig. in text, 1st August: Conflict Atoll, British New Guinea.

Apparently referable to this species are the small adult convex pearl shells found along the Great Barrier Reef. These are easily separated by their crass growth for their small size, their purple and white coloration, and the very convex valves. This is the species most commonly regarded as " *vulgaris* Schumacher ".

Pinctada epitheca sp. nov. (Plate V, figs. 14, 14*a*.)

Hedley included *Meleagrina tegulata*, and as the species had been described by Reeve (' Conch. Icon.' X, pl. vii, sp. and fig. 17, March, 1857) from Moreton Bay, it had a valid right. Unfortunately the name is invalid, so that a new name is required.

This is a mainland coastal shell, the specimen figured coming from Townsville. It is recognizable at sight by the very reduced rostrum and very prolonged posterior auricle, its coloration and sculpture being also distinctive. Shell of medium size, thin, left valve moderately convex, right valve comparatively flat, form remarkable. The length is about equal to the breadth, but the hinge line continues into an auricle after the style of the " Pterioid " species. The rostrum is also so repressed that the anterior side of the left valve shows no sinuosity, while the posterior auricle causes a deep sinus on that side. The coloration is somewhat dull brownish, indistinctly rayed with paler shades, and interiorly the margin is also a pale translucent horny brown. The shell is fairly smooth,

subdued growth lappets being seen in early growth. and existing as very depressed scales towards the margin. The hinge line is long, the ligament long and shallow, the teeth very delicate, almost obsolete. The specimen measures 70 mm. along the hinge line, but only 65 mm. across the body, while the height is 63 mm.

It may be noted that Jameson simply recorded *tegulata* among his list of species of uncertain position without comment, although the type was before him. Yet the form was well known, and had been for more than a century as Jameson included, apparently as a valid species, *M. chemnitzii* Philippi, and this species is of the same peculiar style as the shell above described.

Chemnitz (' Conch. Cab. [Martini] ', VIII, p. 135, pl. lxxx, fig. 720, 1785) described and figured a shell from Tranquebar, which Pfeiffer (' Kritisches Register ', p. 76, 1840) determined as " *Avicula atlantica* Lam. 8, var., Desh.", but which is apparently a near relation of the species here figured.

Philippi (' Zeitschr. für Malak.' VI, p. 19, May, 1849) described *Avicula chemnitzii* from the China Seas, giving Chemnitz's figure as representing his species well. Dunker (' Conch. Cab. [Martini and Chemnitz] ', ed. Kuster, VII, abth. 3, p. 15, pl. iii, fig. 5, 1872) figured Philippi's species, and suggested relationship with Reeve's *lentiginosa* (' Conch. Icon.' X, pl. vi, fig. 13, March, 1857) from the Moluccas. The latter is more scaled and a little differently shaped from the Australian form.

Pinctada perrutila sp. nov. (Plate V, fig. 15.)

Shell rather small, thin, subcircular, comparatively flat; left valve a little convex, bulging posteriorly. Coloration a somewhat uniform dark purplish red, a juvenile showing paler radials. The rostrum is very small, but the byssal gape definite, while the posterior margin shows a slight sinuation just below the hinge. Internally the nacreous area is rather small, with an extensive purple margin. The sculpture consists of crowded, flattened, concentric laminae, with a little crimping but scarcely developing lappets.

The hinge line is long, the ligament rather short, the teeth very small and delicate, the anterior ones rather distant from the ligament.

The specimen figured is from North-West Islet, Capricorn Group, and measures 47 mm. across and 43 mm. in height.

Two smaller shells agreeing were collected at Low Isles. Dunker (' Conch. Cab. [Martini and Chemnitz] ', ed. Kuster, VII, abth. 3, p. 44, pl. xiv, fig. 3, 1872) described a somewhat similar-looking shell as *Avicula tristis*, from unknown locality, but "*solidula*" does not apply to the present species. Dunker (*loc. cit.*, p. 78) later regarded his species as identical with *A. nigra* Gould, described from Singapore.

Pinctada placunoides Reeve, 1857.

1857. *Avicula placunoides* Reeve, Conch. Icon. X, pl. xvii, sp. and fig. 68, June : Australia.

The features indicated by Reeve are the thin *Placuna*-like structure and coloration ; he, however, states it is " flat ", so that rules out the common purple-blotched convex species. Messrs. M. Ward and W. Boardman dredged a specimen from 9–12 fathoms

in Port Curtis, which answers fairly well to the figure, save that it is practically monochrome.

Jameson simply includes the name among his species of uncertain position, though the type was available to him. My colleague, Mr. G. P. Whitley, picked up a series of dead shells on the mainland beaches east of Cape Gloucester, Mid-Queensland, *i. e.* on the coast traversed by Jukes, between Cape Hillsborough and Cape Upstart, two points commonly mentioned in connection with shells collected by Jukes. In the case of *placunoides* the only locality given is Australia, but one of the shells secured by Whitley agrees in shape and coloration with Reeve's figure. Shells generally agreeing were collected at Low Isles.

Pinctada irradians Reeve, 1857.

1857. *Avicula irradians* Reeve, Conch. Icon. X, pl. x, sp. and fig. 35, March : Australia.

Specimens agreeing with this figure in sculpture and shape but not in colour are from Port Curtis and Caloundra. The small ear, rather thick shell and close scalloping are the notable features and these bring it close to the shells determined as *sugillata* and *aerata*, but at present it would be unwise to allow any more lumping.

Pinctada reeveana Dunker, 1872.

1872. *Avicula* (*Meleagrina*) *reeveana* Dunker, Conch. Cab. (Martini and Chemnitz) ed. Kuster, VII, abth 3, p. 45, new name for—

1857. *Avicula fimbriata* Reeve, Conch. Icon. X, pl. ix, sp. and fig. 25, March : North-west coast of Australia, J. E. Dring.

Jameson regarded this as synonymous with the prior *sugillata* Reeve, but there are specimens in this Museum from Port Darwin collected by Mr. A. Livingstone, agreeing in the curious oblique form and massive lappet-sculpture. The very small rostrum and protruding anterior margin below the byssal opening appear quite constant, and it may have been correctly recorded from Torres Straits, by Jameson, though he subordinated it to *sugillata*. In New South Wales a form closely related occurs, differing in its large size, and this species must be regarded as distinct.

Pinctada sugillata Reeve, 1857.

1857. *Avicula sugillata* Reeve, Conch. Icon. X, pl. ix, sp. and fig. 27, March : Cape Hillsborough, North Australia.

Jameson admitted this, ranging as synonyms *fimbriata* Reeve = *reeveana* Dunker and *irradians* Reeve, shifting Cape Hillsborough into North-West Australia, and giving as range, Port Essington and Torres Straits. Cape Hillsborough is, however, in Mid-Queensland, a little north of Mackay, on the east coast, and shells agreeing were collected by Mr. Whitley east of Cape Gloucester, a few miles north of Cape Hillsborough.

As above noted, *aerata* and *irradians* are not unlike this species, but each must be conserved as distinct at present. Prashad (p. 101) recorded *P. sugillata* Reeve from the

East Indies, copying Jameson's synonymy and observing, "As Jameson remarked, the form of the shell of *P. sugillata* is very variable. . . . All previous records of *P. sugillata* are from the Australian waters".

There is not a deal of variation seen in Australian specimens.

Pinctada lacunata Reeve, 1857.

1857. *Avicula lacunata* Reeve, Conch. Icon. X, pl. x, sp. 29, figs. 29–31, March : Australia.

Four small specimens from Station XXIII, Low Isles, come nearest to the figures and description of this species. The left valve is convex and in general form the shell agrees with text-fig. 31, but that figure only shows the right valve, without any details of shape. In all these specimens the valve is for half its length convex, and then flattening out, fits tightly to the convex left valve, being thus very concave for the marginal moiety. The coloration is greenish to white, rayed with purple, becoming uniform greenish with age.

Jameson included this species among those of uncertain position without comment, though the type was before him.

Pinctada aerata Reeve, 1857.

1857. *Avicula aerata* Reeve, Conch. Icon. X, pl. x, sp. and fig. 32, March : Australia.

Specimens agreeing very closely with the figure are from Albany Passage, 9–12 fathoms, and Stradbroke Island.

It seems probable that Reeve's *lacunata* ('Conch. Icon.' X, pl. x, sp. 29, figs. 29, 31, March, 1857) introduced at the same time is the same species, and it is upon such determination that the latter name (*lacunata*) only appears in Hedley's list. However, a shell from Port Curtis, Queensland, which suggests *lacunata* in its coarse sculpture, was determined by E. A. Smith, of the British Museum, as *fimbriata* Reeve, from which it differs, now that more material is available. In Hedley's Queensland list there appears a *Pteria muricata* Reeve, but *Avicula muricata* Reeve ('Conch. Icon.' X, pl. vi, sp. and fig. 12, March, 1857) is a *Pinctada*, very like this series from the Philippine Islands, and as the name is invalid this record can be dismissed altogether.

This species is of medium size, thin, as broad as long, subcircular, rostrum medium, posterior margin distinctly sinuate, right valve a little convex, left valve full and convex. Lappets small and numerous. Coloration bronze green, internal margin large and deep bronze. Jameson included this species among his synonyms of *vulgaris* Schumacher, but it is nothing like any idea of that species.

Pinctada anomioides Reeve, 1857.

1857. *Avicula anomioides* Reeve, Conch. Icon. X, pl. ix, sp. and fig. 26, March : Locality unknown.

Hedley included this species in the Queensland list, probably upon Melvill and Standen's record from Torres Straits, as Jameson remarked, "A young shell, apparently distinct".

The Australian record may be based upon the juvenile of *P. maxima* Jameson.

Pinctada perviridis Reeve, 1857.

1857. *Avicula perviridis* Reeve, Conch. Icon. X, pl. viii, sp. 20, March, 1857 : Australia ; Strange.

I have advocated the usage of this name for the New South Wales species, as Strange collected at Sydney, and the shell described is very young. Since, however, it has turned out that there is more than one species living in Sydney waters. Also specimens from Moreton Bay have been collected agreeing very well with Reeve's figure, and full-grown shells from Edgecumbe Bay and Low Isles appear to be the adults. With the latter juveniles of *maxima* can be easily confused.

Reeve's ' Monograph of Avicula ', published in 1857, shows an extraordinary proportion of invalid names, as follows (according to the ' Index Animalium ') :

argentea (not of Conrad, 1847) Reeve, pl. xvi, fig. 65 . . . . No locality.
eximia (not of Verreuil, 1845) Reeve, pl. xvi, fig. 62 . . . . No locality.
flabellum (not of Conrad, 1842) Reeve, pl. v, fig. 7 . . . . Venezuela.
Jameson gives this as a synonym of *radiata* Leach.
flexuosa (not of Orbigny, 1849) Reeve, pl. iv, fig. 4 . . . . Australia.
marmorata (not of Philippi, 1849) Reeve, pl. xv, fig. 58 . . . No locality.
muricata (not of Hall, 1843) Reeve, pl. vi, fig. 12 . . . . . Philippine Islands.
pica (not of Philippi, 1849) Gould, Reeve, pl. xvii, fig. 71, *maculata*. Pitcairn Island.
pulchella (not of Matheron, 1843) Reeve, pl. viii, fig. 22 . . . Philippine Islands.
radula (not of Koninck, 1842) Reeve, pl. viii, fig. 23 . . . . No locality.
reticulata (not of Phillips, 1841) Reeve, pl. xviii, fig. 74 . . . Australia.
signata (not of Hall, 1843) Reeve, pl. xiv, fig. 56 . . . . . No locality.
tegulata (not of Goldfuss, 1836) Reeve, pl. vii, fig. 17 . . . . Moreton Bay.
Renamed *epitheca* in this essay.
praetexta (not of Conrad, 1842, *protexta*) Reeve, pl. vii, fig. 15 . Philippine Islands.
Admitted by Jameson as a distinct species.

Jameson did not even give a complete list of names in his revision, and even then listed a number as " Species of uncertain position ", but apparently valid, without comment. Another series he listed with the comment " Species of this kind, based upon unlocalized immature and scanty material, can have no scientific value, and only a historic interest ", but with types available he might have given some notes.

Genus *Pedum*.

1791. *Pedum* Bruguière, Ency. Meth. Tab. Vers, pl. 178, on plate only.
Haplotype = *Pedum spondyloides* Lamarck = *Ostrea pedum* Bolten.
1801. *Pedum* Lamarck, Syst. Anim. s. Vert. p. 136, January.
Haplotype : *Pedum spondyloides* Lamarck.
Not *Pedum* Humphrey, 1797.
1815. *Pedinus* Rafinesque, Analyse Nat. p. 147, new name for *Pedum* Lam. *Cf.* Iredale, Proc. Malac. Soc. (Lond.) IX, p. 262, 1911.
Not *Pedinus* Latreille, 1796.

This curious form has puzzled most workers, as it is of such quaint shape and lives in a strange habitat. It is elongated oval, much higher than broad, the hinge line short, the ventral margin rounded, the sides sloping and a little convex anteriorly ; one (left) valve is flattened, the other convex and showing a wide byssal gape below the anterior

margin; it also clasps the flattened valve, but the sides are gaping. The convex valve is smooth and worn, the flattened valve sculptures with radial distant rows of fine prickles. The hinge line is oblique and there is an inwardly projecting chondrophore, carrying a long narrow thick ligament, the hinge on each side being otherwise quite toothless.

Stoliczka ('Mem. Geol. Survey India (Palaeont. Ind.)', 'Cret. Fauna of Southern India', III, 1871, p. 442), commented: "Deshayes censures H. and A. Adams' classification of this genus and places it near *Pecten* on the ground that the right valve is free. It is not more free than in many *Spondyli*, and is found resting on corals with the right valve in exactly similar manner as these do, the consequence being that the radiating striae are generally not developed on the right or larger valve, which also often remains white, while the smaller valve, exposed to light is coloured. The large development of the hinge area, with the ligamental groove passing through it, and the structure of the shell of *Pedum*, undoubtedly show greater affinities to the *Spondyli* than they do to the *Pectines*". Stoliczka then placed the genus in the Spondylidae, noting, "As a rule, the *Spondyli* do not appear to spin a byssus. The animal of *Pedum*, however, always possesses a short byssus, composed of thin threads".

In some lights a great resemblance to *Lima* (sensu latissimo) may be seen, the extended triangular hinge area, the toothless hinge, the byssal notch all being seen in that group. However, probably it is nearer *Malleus*, the colour at first obscuring any reference, but *Malleus* is sometimes whitish and the hinge is very similar, the characteristic byssal groove being seen in *Malleus* as in *Pedum*. Furthermore there is in this Museum a young *Pedum* from San Diego, Mauritius, which has the smaller flat valve coloured blue, as in *Malleus*.

Jackson (p. 390) concluded: "*Pedum* is evidently a descendant of *Pecten*. In the nepionic period *Pedum* is purely pecteniform in both valves, not yet having acquired the peculiarities of the genus. Later, the byssal sinus is enclosed so as to become, in a measure, foraminal, and the shell is apparently closely related to the object of byssal attachment. The right valve is the most highly modified, although both valves are modified, and in the adult condition bear little resemblance to *Pecten*. The peculiar form of the shell of *Pedum*, it may be reasonably inferred, is due to the habit of close byssal fixation."

The specimen before me was taken out of *Porites* and shows the juvenile stage to be blue, as in *Malleus*, and the sculpture on the left valve recalls that of *Malleus*.

Pedum pedum intensum subsp. nov.

1791. *Ostrea spondyloidea* Gmelin, Syst. Nat. VI, p. 3335; based on Chemn. Conch. VIII, t. 72, figs. 669–670: Indies.
Not *Ostrea spondyloidea* Meuschen, Index Zoophyl. Gronov. 1781, for No. 1189, p. 276: Martinique.
1798. *Ostrea pedum* Bolten, Mus. Bolten, II, p. 170, September, for Favanne, pl. 80, fig. K.
1801. *Pedum spondyloides* Lamarck, Syst. Anim. s. Vert. p. 136, January, for Favanne, Chemnitz, and Encycl. p. 178, figs. 1–4.

The Australian shell, of which a nice specimen was taken in *Porites* in the Anchorage, measures 55 mm. in length, 44 mm. in width and 10 mm. in depth. The sculpture on the flat valve consists of prickly radials, fine and rather far apart, twenty in number, the prickles small and distant. The convex valve is apparently smooth, but very finely concentrically ridged. It is smaller and comparatively broader than the typical form, and is therefore named *P. pedum intensum* subsp. nov.

Genus *Malleus*.

1799. *Malleus* Lamarck, Mém. Soc. Nat. Hist. Paris, p. 82, May.
Haplotype : *Ostrea malleus* Linné.
1815. *Malleolus* Rafinesque, Analyse Nat. p. 147, new name for *Malleus* Lam. *Cf.* Iredale, Proc. Mal. Soc. (Lond.) IX, p. 262, 1911.
1815. *Tudes* Oken, Lehrb. Nat. III (1), Reg., p. xvii.
1817. *Himantopoda* Schumacher, Essai nouv. Syst. test, pp. 38, 109.
Tautotype : *H. vulgaris* = *O. malleus* Linné.

The peculiar form of the Hammer Heads is well known, so that it may be shortly described here.

Shell with a long thin body and wings or arms extending laterally both anteriorly and posteriorly. The hinge line is very short, with a long intrusive ligamental area, the oblique direction of the ligament separating the hinge into two areas, the anterior area showing about twenty small crowded vertical teeth, the posterior half a dozen obsolete slanting ones. There is a deep byssal cavity in front of the anterior series.

Malleus malleus Linné, 1758.

1758. *Ostrea malleus* Linné, Syst. Nat. 10th ed., p. 699, January, 1st ref. Bonan . Rumph . " O Asiat."
1801. *Malleus vulgaris* Lamarck, Syst. Anim. s. Vert. p. 133, January, new name for *Ostrea malleus* Linné.
1817. *Himantopoda vulgaris* Schumacher, Essai nouv. Syst. test, p. 109, new name for *Ostrea malleus* Linné ; cites Chemn. VIII, p. 8, t. 70, fig. 655.

The black Hammer Head has only a small hammer, fairly even, with a curved shaft. It is an inhabitant of coral reefs and was found at Low Isles.

Malleus albus Lamarck, 1819.

1819. *Malleus albus* Lamarck, Hist. Anim. s. Vert. VI (1), p. 144, July : Les mers orientales australes.
[1797. *Margaritifera bipennis* Humphrey, Mus. Calonn, p. 44, May ; Endeavour R., N.S.W.]

Although this is recorded as having been collected on the reef off Endeavour River by Captain Cook's party, it is not a reef shell, the black Hammer Head taking its place on the reefs, this white one being the mainland species. It is, however, dredged in waters adjacent to the reef, a specimen being secured at Station IX.

When Lamarck introduced his species he also allowed a white variety of the black Hammer Head, separating the former by the lack of a byssal sinus and general form, and cited 'Chem. Conch.' VIII, t. 70, fig. 656, as representative of the latter. The local white Hammer Heads have a byssal sinus, so that is not of value in determination, but the tropical white forms are distinct in shape.

Genus *Parimalleus*.

1931. *Parimalleus* Iredale, Rec. Austr. Mus. XVIII, p. 205, June 29th.
Orthotype : *P. cursator* Iredale.

I introduced the above names for the shell previously known as *Malleus legumen* in New South Wales. Johnson (' Nautilus ', XXXII, p. 36, October, 1918) has used *Fundella* for a similar shell, but Gregorio (' Bull. Soc. Mal. Ital.' X, p. 72, 20th November. 1884)

had introduced that genus name for his *F. lioyi* from the Mediterranean, probably a young "*regula* Forskål".

The species of *Parimalleus* are elongate and have the general features of *Malleus*, save that they do not produce the hinge line laterally at all, and that the hinge is toothless or nearly so. The species have the right valve plicate for some time, while the left valve is smooth; in *Malleus* both valves are smooth.

Parimalleus rex sp. nov. (Plate V, figs. 18, 18*a*, 18*b*.)

Shell elongate, thick, twisted, coloration blackish blue, hinge line very short, nacreous space square and small, byssal aperture proximate to hinge opening.

The sculpture on the valves is discrepant, the right valve being strongly regularly laminate to begin with, then later irregularly crudely laminate; the left valve is smooth to begin with, but later is coarsely laminate to agree with the laminations of the right, these rough lamellae being really growth stages. Internally the animal lives in a small squarish space, which is subnacreous, the remainder of the long shell being dull and there is a weak ridge medially. The hinge is very narrow, with slight roughening at the side of the chondrophore carrying the ligament, which extends backwards in a deep groove to the apex of the triangular umbonal area; in the right valve the byssal gape is adjacent, and extends alongside the umbonal area to the apex.

The specimen figured is from Low Isles, and measures 75 mm. in length by 28 mm. in breadth, the internal nacreous area being about 23 mm. by 21 mm.

Parimalleus gregarius sp. nov. (Plate V, figs. 16, 16*a*.)

This species is longer, narrower and straighter than *P. rex*, and is generally white, marbled with bluish outside and more or less white inside. The byssal opening is below the hinge and lateral the hinge being short, the chondrophore small, the ligamental groove short and the umbonal area smaller. The hinge shows smooth lines, save posteriorly, where a few small vertical teeth may be seen. The nacreous portion is oblong, half as long again as wide, and along the non-nacreous portion of the right valve is a notable raised rib medially. The edges, moreover, of this valve are a little inturned, clasping the thin edges of the left valve. Externally the earlier part of the right valve is regularly plicate and then the plications disappear, and the shell only shows regular growth lines; the left valve is smooth umbonally and then laminate growth lines occur, a little more marked than in the right. The specimen figured is from Lindeman Island, where it was dredged in numbers, and measures 77 mm. in length by 19 mm. in breadth.

Genus *Reniella*.

1840. *Reniella* Swainson, Treat. Malac. p. 386, May.
Haplotype: *R. dilatata* Swainson.
1798. *Vulsella* Bolten, Mus. Bolten, pt. II, p. 156, September.
Tautotype: *Mya vulsella* Gmelin.
Not *Vulsella* Humphrey, Mus. Calonn, p. 44, 1797, May.
1801. *Vulsella* Lamarck, Syst. Anim. s. Vert. p. 133, January.
Haplotype: *Mya vulsella* Linné.
1847. *Baphia* Gray, Proc. Zool. Soc. (Lond.), 1847, p. 199, November, *ex* Gevers, 1787, non-binomial.
Orthotype: *Mya vulsella* Linné.

1884. *Albisa* Gregorio, Bull. Soc. Mal. Ital. X, p. 57, 20th November.
Logotype, here named, *Vulsella navicula* Gregorio.
1884. *Madrella* Gregorio, Bull. Soc. Mal. Ital. X, p. 57, 20th November.
Logotype, here named, *Vulsella virginis* Gregorio.

This well-known genus appears to be a sponge-living development from a Malleoid source, the hinge toothless, the byssus obsolete, the chondrophore intrusive and enlarged, no arms being needed for such an environment. The sculpture is something like that of *Pedum*.

Reniella vulsella Linné, 1758.

1758. *Mya vulsella* Linné, Syst. Nat. 10th ed., p. 671, 1st January. 1st ref., Mus. Tesserin.; 2nd, Rumph: "In Indiis".
1798. *Vulsella major* Bolten, Mus. Bolten, pt. II, p. 156, September, based on Chemn. VI, t. 2, figs. 10-11: Red Sea and Amboina.
1798. *Vulsella minor* Bolten, Mus. Bolten, pt. II, p. 156, September, based on Chemn. VI, t. 2, figs. 8, 9: Red Sea and Amboina.
1801. *Vulsella linguatula* Lamarck, Syst. Anim. s. Vert. p. 133, January, new name for *Mya vulsella* Linné.
1840. *Reniella dilatata* Swainson, Treat. Malac. p. 386, fig. in text, May: abnormal specimen.

Smith ('Proc. Mal. Soc. (Lond.)' IX, pp. 306–312, 1911) gave an account of the species of this group from Museum specimens. He reduced all the named species to four, but this is very doubtful, as his range of three of the species was co-equal, from the Red Sea southwards, some extending eastwards, New Caledonia being his eastward limit.

The Low Isles specimen is placed here for the present.

Suborder PECTINIFORMES.

The Scallop-like shells appear to form a more or less natural group, though the animal characters have proved puzzling to anatomists. Thus the Amusioid shells, which superficially are simply Scallops, are sometimes grouped as a mere genus in the Scallop family, at others as a subfamily and now as a family, even being widely separated by Ridewood. Further, this worker added *Plicatula* to *Amusium*—a curious association conchologically.

Dall's Superfamily Pectinacea would include the "families" Pectinidae, Spondylidae, Plicatulidae and Limidae of this account. There can be little argument about the close relationship of these when the molluscs are examined in their natural condition. The shells are similar in growth and growth-stages, the animals are all very much alike and the hinge characters are of the same construction. All swim in the juvenile stage and many produce a byssus and become fixed as adults, while some become adherent by the valves and thus sessile.

Davies' review ('Proc. Mal. Soc. (Lond.)' XX, pp. 322–326, November, 1933) indicates the divergence between the acceptance of gill-structure and the real facts, as he deplores the separation thus made between *Pecten* and *Lima*. The crux of the problem is the differentiation of the apparent features into adaptative, progressive and static characters, and the conclusion that hinge-characters appear to be stable, while gill-structure belongs to the progressive series, would give greater value to the former. Here again the development of the hinge must be carefully studied, but the valuation of the observed differences is a matter of difficulty. Thus many have advocated the usage of a genus "*Pecten*", in which the hinge varies from an edentulous form to a heavily-toothed stage, while it may be long or short. Every field worker would accept the close relationship

between "*Pecten*" and *Spondylus*, but whereas the former has commonly a delicately-formed hinge, the hinge of the latter has huge strong teeth. Consequently the stability of the hinge-characters is a disputable point, and we therefore conclude that a consideration of the whole of the taxonomic features is necessary, and that attempts to segregate characters for the purpose of general classification is unwise. Surface sculpture would be classed as progressive, but in many cases it is of great importance and shows little variation, while the hinge is variable.

Family Pectinidae.

The discrimination of the members of this family is very difficult, as only few specimens are secured at a time, unless beds are met with, and none of these occurred. To enable recognition, the immense number of species must be carefully examined and groups utilized. It is somewhat anomalous to degrade such natural groups to a minimum, and then use the group names with higher value, as, *e. g.*, Dall ('Trans. Wagner Free Inst. Sci. Philad.' IV, 1898, p. 689), who wrote: "The Pectens seem to form a natural genus with a profusion of minor modifications, which may be separated for convenience into sections and subgenera, but possesses within certain general limits very uniform characters. The value of the named groups will differ with the personal equation of those who deal with them, but it appears impossible, when the fossils are included, to draw lines of generic demarcation, which shall be clear-cut, yet not in violation of nature." Dall then used his sectional introduction, with subgeneric status, and so on. There are few, if any, "clear-cut" lines of demarcation in nature, and especially in closely-related natural groups, while, if fossils are interpreted without careful valuation of locality and age, only confusion can result.

In southern Australia many different groups of Scallops exist, and their ancestry can be traced by means of the fossils found adjacent. Thus the age of the groups and their long distinction can be proved, and it is possible that none of the tropical forms are congeneric. Most of the latter differ at sight, but some are so similar superficially that they may be associated with the southern shells until more information is available. However, even then we find that apparently only superficial resemblances are responsible for the records of species of wide range. Probably intensive study of the animals will assist in the correct appreciation of the species, as differences can be seen by the naked eye in the appearance of some of the species. Recently a plea was urged that because geologists know little about conchology, the series should be retained under the one genus *Pecten*, so that the geologists could still talk glibly about Pectens, irrespective of the scientific value of their knowledge. Criticism of the Australian species alone shows similarity of form through convergence, and the keenest discrimination is necessary to build up a stable classification showing the natural facts. Consequently the allowance of a pseudo-genus "*Pecten*", even if it would satisfy pseudo-geologists, would be of no assistance to real students of geology, who are even more discriminating in their work than the majority of zoological workers. As a corollary the classing of the Pectens is a matter of great importance to all. After eliminating the well-marked species of distinctive appearance there remains a number of names on the Queensland list which are not accurately determinable. Thus a worker at the British Museum, *e. g.* Smith or Melvill, would record species from Australia which he regarded as agreeing with the species so named in the

collection. Watson, many times in the "Challenger" Report, admitted that this was the course he took, irrespective of whether the earlier determination were correct or not. Thus the personal equation became a large factor and the critical faculty of the worker would greatly influence the decision arrived at. Then, say, workers at Berlin, *e.g.* Martens, would act similarly, but as their collection was less extensive, they would conform and determine by reference to literature, and thus introduce another factor, that of judgment of illustrations—an entirely different matter from comparison of shells themselves. Then the Paris worker, obsessed with the greatness of Lamarck, would arrive at an entirely different solution of the problem. This is exactly what has happened in connection with the scallops, as Smith, Melvill and Standen, and Martens have apparently published different names for the same shell, while Shirley has added a fourth from French authorities' determinations. To particularize, the names *fricatus*, *blandus*, *funebris*, *asperrimus*, *cruentatus*, *lemniscatus*, *lentiginosus*, *limatula*, *pseudolima* appear to refer to three or four species at the most.

Fortunately some specimens in this Müseum were named by Smith some fifty years ago by comparison with the British Museum material, so that we have some idea of the British usage at that time. Shells have also been acquired by exchange from the Paris Museum, so that a consideration of the names adopted by French workers enables reconciliation of records, which would otherwise have been impossible. This leaves the names used by Melvill and Standen to be disposed of, and this is difficult, as the names were selected without careful criticism, as understood to-day. Thus, *blandus* Reeve, *lemniscatus* Reeve, *lentiginosus* Reeve and *limatula* Reeve were given at one time, and it is impossible to determine four distinct species answering to those names in the collections at hand.

Queensland Scallops are separable into many groups which are here regarded as genera, and their characters may be noted thus :

Shell medium, almost equivalve and equilateral, sculpture of scaly radials, regular, ears unequal . . . . *Mimachlamys.*
Shell medium, inequivalve, irregular in shape and with discrepant sculpture on the two valves, ears unequal . . . . . *Scaeochlamys.*
Shell small, inequivalve, irregular in shape, sculpture similar on both valves, ears unequal . . . . *Coralichlamys.*
Shell medium, equivalve, regular, ribs smooth and rather distant, ears subequal . . . . *Volachlamys.*
Shell medium, equivalve, regular, ribs few, stout and very scaly, ears unequal, shell thick . . . . *Gloripallium.*
Shell medium, inequivalve, regular, few radial ribs crossed by strong striae, ears subequal . . . . *Annachlamys.*
Shell large, inequivalve, subregular, few large compound radial ribs, ears subequal . . . . *Comptopallium.*
Shell small, flattened, slightly inequivalve, few large compound ribs, ears subequal, inner margins thickened . . . . . *Decatopecten.*
Shell small, thin, flattened, few large radial ribs with complex sculpture, ears subequal, inner margins thin . . . . *Complicachlamys.*
Shell small, subcircular, very inequivalve, many smooth radials, ears large, subequal, with ctenolium . . . . *Minnivola.*

Shell large, subcircular, very inequivalve, ribs smooth, ears large, equal, no ctenolium . . . . *Notovola.*
Shell small, inequivalve, ribs few, densely scaly, elevated, ears large, unequal . . . . *Excellichlamys.*
Shell small, subequivalve, ribs stout, ears subequal . . . . *Bractechlamys.*
Shell small, subcircular, subequivalve, ribs few, very complexly sculptured, ears unequal . . . . *Corymbichlamys.*
Shell small, subcircular, equivalve, thin, compressed, sculpture very fine, ears unequal, valves internally ribbed . . . . . *Juxtamusium.*
Shell large to medium, subcircular, subequivalve, thin, smooth, valves gaping, ears small, valves internally ribbed . . . . . *Amusium.*
Shell very small, subcircular, compressed, subinequivalve, concentric lirae, valves slightly gaping, ears comparatively large, valves internally ribbed . . . . *Glyptamusium.*
Shell small, flat, subcircular, no radial ribs, lirae discrepant on each valve, nacreous within, ears unequal . . . . . . *Catillopecten.*

Genus *Mimachlamys.*

1929. *Mimachlamys* Iredale, Rec. Austr. Mus. XVII, p. 162, 4th September.
Orthotype : *Pecten asperrimus* Lamarck.

When this genus was proposed the definition was given : " In *Mimachlamys* the valves are both convex, but the left valve is more convex than the right, the auricles are unequal, the posterior being much smaller than the anterior. The byssal gape is deep and very strong, pectinidial teeth are present, a deeply-furrowed fasciole occurring. The sculpture consists of closely-scaled numerous radials flanked with subsidiary more delicate riblets, a deep gutter intervening between each group, which becomes filled up with riblets as maturity is reached. The prodissoconch is smooth, with concentric growth lines, the succeeding sculpture being plain riblets with scratched intervals, the scales developing later. The sculpture on the two valves does not differ appreciably in design."

A number of similar shells occurs throughout Queensland, a southern species very like the South Australian type, the northern shells differing a little in detail.

The Queensland shells, placed under this genus, may be separated as follows :

Radials rounded, twenty to twenty-three—
scales few or obsolete, shell large,
with accessory scaly riblets . . . . *gloriosa.*
with no scaly riblets in interstices . . . . . . *subgloriosa.*
ribs without scales twenty-seven in number . . . . . . *cruentata.*
Radials rounded, profusely scaly, twenty-two ribs—
scales closely set, size small . . . . *curtisiana.*
rounded profusely scaly, ribs twenty, scales distant . . . . *ellochena.*
Radials rounded, scales distant, ribs twenty with intercalating minor ribs, shell very small, shape distinct . . . . *deliciosa.*
Radials angulate, scales very small and distant, ribs twenty-six, coloration peculiar . . . . *gavena.*
Radials flattened, major riblets fifteen to thirty, minor intercalating ones twice as many, scales missing, coloration peculiar . . . . *grossiana.*

Mimachlamys gloriosa Reeve, 1853.

1791. *Ostrea senatoria* Gmelin, Syst. Nat. VI, p. 3327, for Chemn. Conch. VII, t. 65, fig. 617 alone : " O. Indico " = Moluccas.

Chemnitz's shell came probably from the Moluccas, and is well described (p. 320) with twenty-two rounded subscabrous ribs. Reeve (' Conch. Icon.' VIII, pl. xxi, fig. 81, May, 1853), figured the species from the Moluccas, obviously Gmelin's shell. Chemnitz named the shell " *Pallium senatoris* ", which Gmelin altered to the meaningless *senatoria.* Dautzenberg and Bavay (' Siboga-Expeditie ', LXIII, mon. liii*b*, November, 1912) dealt with the specimens of this family collected by that expedition, recording forty-four species, including nine new species from deep water. Their treatment is quite unlike mine, as they ignore geographical boundaries, and allow many varieties, sometimes living together. Thus, in the present case, they call the species *Pecten* (*Chlamys*) *senatorius*, with synonyms, *Ostrea citrina* Gmelin (' Syst. Nat.' VI, p. 3327, 1791 ; India), *Pecten aurantius* Lamarck (' Hist. Anim. s. Vert.' VI, pt. 1, p. 175, 1819; Indian Ocean ?), *P. florens* Lamarck (*ibid.*, Indian Ocean ?), *P. crassicostatus* Sowerby (' Thes. Conch.' I, p. 75, pl. xv, fig. 111 ; pl. xvii, fig. 152, 1842; locality unknown), *P. similis* Baird (' Cruise Curaçoa ', p. 453, pl. xlii, fig. 7, 1873 ; (Tongatabu) citing four colour varieties, which they apparently regarded as of less value than their varieties, though they gave names to them, viz. *citrina* Gmel. = *aurantia* Lamarck, *florens* Lamarck ; var. *lilacina* and var. *articulata,* newly introduced. They then ranged as varieties *Pecten miniaceus* Lamarck (' Hist. Anim. s. Vert.' VI, pt. 1, p. 177, 1819 ; locality unknown ; figured by Delessert, ' Recueil Coq. Lam.' pl. 16, figs. 6*a*, *b*, 1841), *Ostrea porphyrea* Gmelin (' Syst. Nat.' VI, p. 3328, 1791 ; Red Sea) and *Pecten nobilis* Reeve (' Conch. Icon.' VIII, pl. i, fig. 3, November, 1852; Japan), giving as a synonym *Pecten gloriosus* Reeve (' Conch. Icon.' VIII, pl. xxx, figs. 134*a*, *b*, 1853). The last name was introduced by Reeve in his Index, issued August, 1853, to replace his second *Pecten nobilis,* figured on the plate above quoted (pl. xxx, figs. 134*a*, *b*, June, 1853), inadvertently used for a Moreton Bay shell, different from the true Japanese *nobilis.* According to Dautzenberg and Bavay's determination, their *nobilis* is restricted to Japan, so obviously they did not include the Moreton Bay species, save from the illustration, whose locality they doubted. Geographically, most of the names quoted may be assigned to the East Indian species, *senatorius* Gmelin = *citrinus* Gmelin = *aurantius* Lamarck = questionably *florens* Lamarck, and doubtfully *crassicostatus* Sowerby. Lamarck's *miniaceus* does not appear to be referable here at all, while *porphyrea* Gmelin is a distinct Red Sea species, *nobilis* Reeve is a very distinct Japanese form, and *gloriosus* Reeve is the easily separable Queensland species.

Numerous valves, picked up on the beach at Friday Island, Torres Straits, by Mr. Melbourne Ward, vary in size from 25 mm. to 48 mm. in height, by 22 mm. to 44 mm. in breadth. All are whitish, mottled with dark shades of pinkish red outside, and varying from pale pink to dark rose internally. The number of ribs is constant, between twenty and twenty-three, and the ribs bear regularly placed, rather distant scallop scales, the ribs rounded, the interstices finely radially scratched. The scales are easily broken off so that worn specimens appear smooth and the interstitial sculpture becomes fainter. These definitely agree in every detail with the Low Isles shell figured. Specimens from Mapoon, not very far away, in the Gulf of Carpentaria, are rounder, more convex, the scales even more pronounced, the largest specimen resembling typical *gloriosa*, but with much

less pronounced sculpture in the intervals between the ribs, and especially towards the edges. Other shells from Anson Bay, North Australia, agree in shape and ribbing and also in coloration with the Mapoon shells ; in these the white predominates and the pink blotches are fewer and more scattered and the inside is white with pale pink blotching. A New Caledonian shell received from the Paris Museum as " *senatorius* var. *gloriosus* " differs at sight in being a longer shell, lacking the lateral spreading of typical *gloriosus*, and being brownish red outside and reddish brown inside ; another series of four shows smaller shells, redder, but still uniform, some white inside.

The Paris Museum determinations of New Caledonian shells as *P. senatorius* var. *gloriosus* and *P. senatorius* var. *crassicostatus* do not agree with the typical illustrations. In the former case, the shell so named is rather deep and notably longer than broad, with ribs overridden ventral with concentric striæ ; in the latter the shell is prickly, similar to our shells, which have been regarded, perhaps also wrongly, as *lentiginosus*. The figures of *gloriosus*, from Moreton Bay, show a very large subcircular shell, with twenty-two ribs, thinly scaled at sides towards margin, interstices deep, almost as wide as ribs, and finely serrately ridged near the margin only. Reeve's figure of *crassicostatus* is of a similar very large subcircular shell, but with twenty-four rounded, well-separated ribs, obscurely ringed, interstices smooth, while Reeve's idea of *senatorius* from the Moluccas is of a large similarly-shaped shell, but with smaller ears and with twenty to twenty-four closely set obtusely serrated ribs.

Specimens now available from Moreton Bay agree exactly with Reeve's figure and description of *gloriosus*, and are easily separable by the rib formation from *crassicostatus* or *senatorius*, while the Low Isles shell figured has much smaller ears, and the ribs are quite different ; so it is here described under the name *M. subgloriosa* infra.

Mimachlamys ellochena sp. nov. (Plate V, fig. 24.)

A valve dredged at Station XVII, and here figured, measures 30 mm. in breadth and 33 mm. in height. Its coloration is a pale bright red outside, the inside being white, the edges pink. The sculpture consists of twenty ribs, rounded, the interstices deep and narrow, the ribs covered with small distant elevated scallops, more noticeable at the sides, worn down or off medially. The umbonal smooth area is small, the succeeding sculpture being smooth radials which, however, show prickles at the sides at a very early date. The right valve is not very convex. The hinge line is long, the cardinal crura strong, well defined and finely regularly denticulate ; the ligamental groove is equilaterally triangular, the elevated sides being finely denticulate. The ears are unequal, the posterior ear small, rayed with seven or eight rows of prickles ; the anterior one large, similarly ribbed with stronger rows of prickly ribs. Pectinidial teeth six in number, separated and strong.

Mimachlamys subgloriosa sp. nov. (Plate V, figs. 21, 21*a*.)

Shell medium, valves of even convexity, distantly but numerously ribbed, ribs scale-bearing, ears unequal, shell almost equilateral as well as almost equivalve. Coloration purplish white, blotched with darker, inside pinkish white, and dark purplish red towards the margin. The ribs number twenty-two and are fairly elevated, rounded, interstices deep and practically smooth, only showing a faint concentric threading under a strong

lens. There are no interstitial riblets nor small accessory ribs, so that this separates it widely from *gloriosa*, which shows both these kinds of ribs. The ribs have developed fairly large erect scales and these can be traced back to a very early stage, the umbonal smooth area being very small, and the ribs following becoming scaly very quickly. The ears, save the anterior one of the right valve, are weakly sculptured with prickly radials ; the anterior right ear is shortly ribbed with seven densely scaly ribs. The hinge-line is weak, the cardinal crura weak but finely denticulate, as are the ridges at the side of the triangular ligamental pit ; auricular crura weak. Byssal opening small, the ctenolium showing three strong teeth.

The Low Isles specimen figured measures 43 mm. in height, 40 mm. in breadth, and 14 mm. in depth.

Under the title "*Pecten senatorius* (Gmelin), var." Smith ('Rep. Sci. Res. "Challenger" Zool.' XVI, p. 300, 1885) reported as follows : "The single specimen from Station 208 (18 fathoms Philippine Islands) and two from Station 203 (20 fathoms) differ from each other in colour and also somewhat in sculpture. Both forms are also very unlike the *Pecten senatorius*, as figured in Reeve's work as regards colour, but after careful consideration and comparison I do not think it advisable to separate them. The former specimen has more the general appearance of *Pecten layardi*, Reeve, the other two more resembling *Pecten rugosus* of Sowerby. There is a large group of species which requires careful investigation, and which probably could be considerably reduced in number. It comprises *Pecten senatorius*, *Pecten cruentatus* Reeve, *Pecten gloriosus* Reeve, *Pecten crassicostatus* Sowerby, *Pecten nobilis* Reeve, *Pecten layardi* Reeve, *Pecten cristularis* Adams and Reeve, *Pecten rugosus* Sowerby, *Pecten triradiatus* Reeve, *Pecten testudineus* Reeve, *Pecten cloactus*, Reeve, *Pecten miniaceus* (Lamk.) Sowerby, *Pecten pseudolima* Sowerby, *Pecten blandus* Reeve, *Pecten fricatus* Reeve, *Pecten reticulatus* Reeve, and *Pecten saniosus* Reeve. The small forms may possibly be but young shells of the larger ones, for we do not know the limits in size of many of the exotic species."

Mimachlamys cruentata Reeve, 1853.

1853. *Pecten cruentatus* Reeve, Conch. Icon. VIII, s. 69, April: Cape Upstart, North Queensland.

This species is easily recognized when shore shells are examined, as it ranges all along the coast line and is ribbed as most of the *Mimachlamys*, but the ribs do not bear scales, being smooth and convex. As described, there are twenty-seven flatly convex close-set smooth ribs, the central ones broader.

Mimachlamys deliciosa sp. nov. (Plate V, figs. 22, 22*a*.)

Shell very small, equivalve, a little inequilateral, both valves convex, ears very unequal, sculpture prickly. The coloration is uniform, orange brick. For comparison *Pecten sentis* Reeve (' Conch. Icon.' VIII, pl. xxix, sp., fig. 125, June, 1853), from unknown locality, may be cited, but Reeve's shell is much broader and more subcircular. The sculpture consists of about twenty-two primary ribs, which are almost doubled by intercalating ribs with age. All the ribs are ornamented with erect prickly scales very regularly but not closely placed, the scales never developing scalloping nor overlapping. The

interstices between the ribs appear to be smooth ; the initial smooth umbonal portion is very small, and the radial ribs begin rather strongly, almost immediately, no concentric striation nor radial scratching being observed, but the right valve shows somewhat rude concentric growth stages. The radials on the ears number nine to twelve, and the ctenolium is strongly toothed. the byssal gape rather small. The hinge for such a small shell, is strong, the two cardinal crura well developed and closely denticulate. Height 17 mm., breadth 14 mm., depth of conjoined valves 6·5 mm. Habitat, Low Isles, Station 14, five complete specimens. This small species is easily separated from the young of any of the larger species by means of its complex sculpture.

Mimachlamys curtisiana sp. nov. (Plate V, figs. 19, 19*a*.)

Smith in the "Alert" Report (p. 116) included *Pecten funebris* Reeve ('Conch. Icon.' VIII, pl. xxii, sp. and fig. 85, May, 1853 : "Bathurst, Australia" = Bathurst Island, Northern Australia), from Port Curtis, collected by Coppinger, and hence this specific name appears in the Queensland list. Many specimens from Port Curtis disagree in shape, number of ribs and detailed sculpture with Reeve's figure, and specimens from North-West Australia exactly coincide with the latter, so that the Queensland shell is here described. The specimen I recorded (' Proc. Zool. Soc. (Lond.) ' 1914, p. 666) from the Monte Bello Islands as *C. lentiginosus* var. is undoubtedly *funebris*, and Hedley, in his West Australian list, included it as *P. cruentatus* Reeve var. *lentiginosus* Reeve, which entry must now be amended to *funebris* Reeve. The Port Curtis shell is comparatively small, both valves convex, the left of greater convexity than the right, posterior ear very small, right ear fairly large, shell stout for its size. The ribs are rounded, twenty to twenty-two in number, bearing regular rather crowded erect scales, which become a little less prominent with age. The umbonal portion is smooth and is followed by well-developed radial ribs, the interstitial sculpturing varying a little in the two valves ; a punctulate "*Camptonectes*" form persisting in the left valve, but being replaced at an early stage by a radial scratching in the right valve. The type measures : height 28 mm., breadth 25 mm.

Mimachlamys gavena sp. nov. (Plate V, fig. 28.)

Shell of medium size for this group, equivalve, a little inequilateral, both valves convex, ears unequal. Coloration a little varied, usually of dark hue, the young dirty white blotched with purplish, the latter colour predominating in the adult, the interior liver-brown, the juvenile showing whitish with brown blotches. The ribs number twenty-six, angulately convex, with moderately deep interstices, anterior ear with five strong ribs, posterior ear with five not so bold in the right valve, the ears in the left valve showing seven and four weaker ribs respectively. The umbones are smooth, and the earlier radials show only faint scaling, which becomes more pronounced with age, while the interstices appear to be smooth, no definite sculpture being discernible under a good lens. The anterior ears are fairly large in the young stages, and are denticulate by the strong auricular ribbing, but no auricular crura are present. The adult shell appears to gape a little at the sides, the byssal sinus medium, the teeth of the ctenolium few and strong. The cardinal crura are fairly well marked, but encroached upon by the hinge line in the

adult, when no denticulation persists, though it can be seen in the immature specimens; the ligamental pit is very deep and comparatively narrow in the adult stage.

The shell figured, from Low Isles, measures 42 mm. in height, 39 mm. in breadth and 15 mm. in depth.

Specimens from New Guinea, received from the Paris Museum under the name *P. cruentatus* var. *lentiginosus*, are like *gavena* in coloration and form, but bear less scales and lack the fine dorsal sculpture.

Martens has recorded *Pecten fricatus* Reeve from Thursday Island, but Reeve's shell was described from unknown locality, and the description reads "very finely serrated, lateral ribs minutely scaled", so that probably this species was intended by Martens. Otherwise Reeve's figure is of a different shell from ours, being more rounded, the coloration different, the ribs disagreeing, etc.

Dunker ('Malak. Blatter', XVIII, p. 173, August, 1871) introduced *Pecten rubellus* for a Rockhampton shell, but the description is not satisfactory, and the number of ribs is not given, nor any measurements; the "dichotomous" costae are quite a foreign feature for any species of this family.

Mimachlamys grossiana sp. nov. (Plate V, figs. 23, 23*a*.)

Shell rather small, longer than broad, nearly equilateral, subequivalve, of medium convexity, ears very unequal. The sculpture is less pronounced than in other members of this genus, and immature specimens generally lack all the prickly sculpture, though in the adult the major ribs bear small distant prickles. The beginnings of the valves are smooth; these are succeeded by plain radial riblets, the intervals between being finely obliquely radially scratched and minor riblets soon appearing. These minor riblets soon multiply, the minute scratching becoming finer and finer, until it disappears. The major riblets persevere, a little stronger than the minor ones which fill the interstices, and on these major riblets small prickles appear, placed far apart. On the right valve these major riblets number about fifteen, there being from three to six minor ones between each major one; all the riblets are flattened. The major riblets are more numerous on the left valve, up to thirty being counted, with only one or two minor ones between. The prickles are also placed nearer together. The external coloration is red, mottled with black, but internally the coloration is a pale reddish fawn, the edges of the shell internally being dark brownish red. Sometimes there is a red-brown patch in the centre of the shell inside. The anterior ears are large, the posterior very small, the anterior auricle of the right valve being strongly sculptured with five coarse ribs, the other ears all being finely sculptured. The byssal sinus is very large, the ctenolium rather short, but the teeth stout; no auricular crura, but the ears appear to gape a little. The cardinal crura are indistinct, a ridge running along each side subparallel to the hinge line; the latter is microscopically striate, but the crura themselves appear smooth. The edges of the shells irregularly crenulate and sharp, not regularly toothed, as in most species in this group. A small valve and a larger broken valve were picked out of the 9–12 fathoms' dredging off Low Isles, but the type figured is a beautiful specimen collected by that energetic conchologist, Mr. George Gross, on Stradbroke Island, Moreton Bay, Queensland. Its measurements are: Length 44 mm., breadth 40 mm., depth of valves 14 mm.

A very similar shell, in the Australian Museum collection from New Caledonia, is named *Pecten squamosus* Gmelin var. *hybridus* Lamarck. It is impossible to use Lamarck's name, as it is merely a usage of Gmelin's *O. hybrida*, with which he incorporated Gmelin's *O. squamosa*. Gmelin introduced his *Ostrea hybrida* (' Syst. Nat.' VI, p. 3318, 1791) for a shell from the Norwegian Seas, citing ' List. Conch.' t. 173, fig. 10, and ' Chemn. Conch.' VII, t. 63, figs. 601, 602, neither of which have anything to do with the tropical species under notice.

The same species, even very similar specimens, was named by E. A. Smith, of the British Museum, *Pecten serratus* Sowerby from New Caledonia, but the shells look much more like *P. irregularis* Sowerby, figured on the same plate.

Melvill and Standen (p. 183) recorded *Pecten cuneatus* Reeve from Torres Straits, and there appears to be confusion with *irregularis* Sowerby, *serratus* Sowerby and *squamosus* Gmelin.

Gmelin's *Ostrea squamosa* (' Syst. Nat.' VI, p. 3319, 1791) was based on " ' List. Conch.' t. 184, fig. 21 ", from unknown locality.

Dillwyn (' Index Hist. Conch. Lister ', p. 14, 1823) has commented : " The *Ostrea* No. 35 of Schroeter and both the *Ostrea squamosa* and the *Ostrea anonyma* of Gmelin have been derived from this figure, which is considered by Lamarck to be a variety of *Ostrea hybrida* ; these two of Gmelin's species, and this figure, have been erroneously quoted in the Descriptive Catalogue for *Ostrea pellucens*."

Dautzenberg and Bavay (' Siboga Exped.' LXI, mon. liii*b*, p. 140 (14), December, 1911) used *Pecten squamosus* Gmelin, but overlooked the citation of *Ostrea anonyma* Gmelin (' Syst. Nat.' VI, p. 3329, 1791) as a synonym, though it had been provided for the same figure of Lister, even as Dillwyn had recorded. They regarded as synonymous, however, *Ostrea sauciata* Gmelin (VI, p. 3328, 1791, for ' Chemn. Conch.' VII, t. 69, fig. H : Red Sea), *Pecten serratus* Sowerby (' Thes. Conch.' I, p. 69, pl. xiii, fig. 56, 1842 : Philippine Islands), *Pecten larvatus* Reeve (' Conch. Icon.' VIII, pl. xxxiv, sp. 158, figs. 158, 165, August, 1853 : Philippine Islands), and *Pecten dissimilis* Fischer (' Journ. de Conch.' VII, p. 341, June, 1859, *ex* Montrouzier MS. : new name for *Pecten serratus* Sowerby). In the same place *Pecten irregularis* Sowerby (' Thes. Conch.' I, p. 69, pl. xiii, figs. 51 and 52, 1842 : no locality) was allowed as a valid species, Reeve's *P. lemniscatus* (' Conch. Icon.' VIII, pl. xxxv, fig. 170, August, 1853, as *lentiginosus* : no locality ; name altered in Index) being added as a variety. The tropical species known as *P. lividus* was determined as *squamosus*, the true *lividus* Lamarck having been described from South-West Australia. A form of *lividus* Lamarck (*i. e. Scaeochlamys*) reaches into southern Queensland as far north as Port Curtis, but this has nothing to do with the species now being dealt with, which might be associated with any of the other names quoted above except *lemniscatus*. The true *lividus* has always a heavy scaly sculpture on the ribs of the left valve, which is not seen in any of the figures cited above. Consequently the names must be allotted geographically, and *squamosus* Gmelin must be determined from the figure, and certainly it is not applicable to an Australian shell. Gmelin's *sauciata* must be relegated to the Red Sea, and *Pecten serratus* Sowerby, *Pecten larvatus* Reeve and *Pecten dissimilis* Fischer all refer to a Philippine Islands species, the first-named being preoccupied, and if *larvatus* Reeve be the same, that name anticipated Fischer's *dissimilis*, which is applicable only to the Philippine Islands shell, but is invalid through Fleming's *P. dissimilis* (' Hist. Brit. Anim.' p. 387, 1828).

[*Pecten gemmulatus* Reeve, 1853.

Reeve described a species from New Zealand under the above name (' Conch. Icon.' VIII, pl. xxvii, sp. and fig. 111, May, 1853), and it was long used as a varietal name for a form of *novaezelandiae* Gray. Examining the type in the British Museum it was found to differ entirely from the traditional determination, and, moreover, was labelled " Moreton Bay ". There were no specimens at all like this species from New Zealand, so I advised (' Trans. New Zeal. Inst.' XLVII, 1914, p. 486, July, 1915) its rejection from that fauna, and its investigation by Australian workers. The problem has now devolved upon myself, and again no Australian shell could be made to agree with the figure, and description of the Reevean species, but in the meanwhile Capt. Bollons had secured many shells from the stomachs of blue cod in Cook Straits, which were regarded as *P. radiatus* Hutton. These prove to be the elusive *gemmulatus*, the form and sculpture and even coloration agreeing closely. After making this determination, I found that Hedley had arrived at the same conclusion, so it can be regarded as definite. The interstitial sculpture appears to be microscopical radial scratching throughout.]

Genus *Scaeochlamys*.

1929. *Scaeochlamys* Iredale, Rec. Austr. Mus. XVII, p. 162, 4th September.
Orthotype : *Pecten lividus* Lamarck.

The irregular shape, the discrepant sculpture and size will easily distinguish this group, which is based on a shell from South-West Australia ranging round to New South Wales and advancing northwards into Queensland as far as Port Curtis.

The minute sculpture detailed in the original diagnosis of the genus appears to be characteristic among Australian Chlamydoid forms, and while no specimens have yet been recorded from North Queensland, similar shells recur in New Caledonia.

Shell of medium size, valves a little inequilateral, tending to distortion, but dredged specimens sometimes comparatively regular, inequivalve, the left valve more convex than the right, ears unequal, anterior ears large, byssal gape and pectinidial teeth very pronounced. Sculpture discrepant, few prominent scaly ribs on the left valve, numerous less scaled ribs on right valve. The hinge shows one ridge subparallel to the hinge line, not striate, and a short bounding rib on each side of the broad ligamental pit.

Scaeochlamys livida Lamarck, 1819.

1819. *Pecten lividus* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 178 (February–June = 31st July) : King George's Sound, West Australia.
1828. *Ostrea tegula* Wood, Suppl. Index Test, p. 7, pl. 2, Ostrea, fig. 3 : No locality (Mawe Cabinet).
1835. *Pecten foliaceus* Quoy and Gaimard, Voy. " Astrolabe ", Zool. III, p. 445, pl. lxxvi, figs. 4–6 (after 17th March) : King George's Sound, West Australia.

Lamarck described this species from a specimen in the Paris Museum from King George's Sound, West Australia, apparently collected by Péron and Lesueur. It was not figured, but it is very curious that Quoy and Gaimard named and figured a *Pecten foliaceus* from the same locality, especially as they were working at the Museum. In the meantime Wood, in England, had figured *Ostrea tegula* from a shell in Mrs. Mawe's collection.

Twenty years later, monographing the "genus" *Pecten*, Reeve figured a Sydney shell under the name *Pecten tegula* Wood, commenting, "Distinguished from all other Pectens by its irregular foliaceous-scaled *Spondylus*-like growth". At the same time he used *Pecten lividus*, as of Lamarck, for a very different shell, but never mentioned *P. foliaceus* Quoy and Gaimard. Subsequently the errors were continued, and then we find Dautzenberg and Bavay recording that the tropical shells, commonly regarded as *lividus*, were not Lamarck's species, but should be referred to *squamosus* Gmelin. Specimens from New Caledonia received from the Paris Museum, with a label "*Pecten lividus* Lmck., *non* Auct., var. = *tegula* Wood", are, however, of the true *lividus* style.

While *lividus*, as shown above, was described from King George's Sound, West Australia, and the locality confirmed by Quoy and Gaimard, with their *Pecten foliaceus*, and a species called *lividus*, is common about Sydney, there is no record from South Australia, Tasmania or Victoria, so that instead of the group being a southern one it is apparently a northern series.

Quoy and Gaimard's illustration is not unlike the New South Wales shell, but the swollen left valve and the flattened right valve and the fewer ribs appear to separate the western form, which must be emphasized on account of the discontinuous distribution. However, the figure given by Wood for his *O. tegula* is of a shell $2\frac{1}{2}$ in. long and much narrower than high, whereas the local shells are all comparatively broad and have more strong ribs, the figure only showing eight at the most; the Sydney shell has twelve or more ribs. As Wood had West Australian shells at his disposal, the only course open is the designation of King George's Sound, West Australia, as the type locality of *Ostrea tegula* Wood, and thus dispose of the name. Probably the type is lost. Thus the only possible course is the description of the Eastern Australian shell as *Scaeochlamys livida peroniana*.

Shell of medium size, subequilateral when young, sometimes distorted when adult, inequivalve; valves with discrepant sculpture, almost as broad as long, coloration variable right valve usually paler than left. The ears are unequal but less so in left than right valve. The sculpture of the right valve, following the umbonal smooth portion, consists of about twenty smooth ribs with slight interstitial scratching; with age intercalating ribs intervene and a slight growth of prickles begins. Very rarely do large scalloped scales appear. On the left valve the sculpture in the adult consists of a few broad ribs bearing large erect scalloped scales, the young valve having begun similarly to the right, but with broader, flatter, fewer ribs, with notable interstitial scratching, and on the ears "*Camptonectes*" sculpture, and this may sometimes be seen between the ribs in the adult shell on both valves. A medium-sized valve measures 54 mm. in breadth and 54 mm. in length or height, while a large one measures 75 mm. in length or height and 71 mm. in breadth. The type is a Sydney Harbour shell.

Genus *Coralichlamys* nov.

Type: *C. acroporicola* sp. nov.

Shell thin, irregularly elongate, "*Chlamys*" form, equivalve, inequilateral, both valves lightly convex, ears very unequal. The juvenile is regular in form, with a minute smooth prodissoconch, followed by a punctate sculpture, from which radials arise. The adult sculpture consists of numerous radials overrun by concentric elevated scales, continuous with similar latticing in the interstices. In the juvenile form the ears are

normally unequal, but in the adult the posterior ear becomes lessened as the valve spreads. The byssal notch is deep, and the ctenolium is short and strongly toothed. The hinge shows no cardinal crura, and only a faint denticulation along the edge, the ligament extending deeply, and being elongately produced. A strong ligamental area is developed, taking the place of the crura, and causing the shell to be gaping a little throughout.

Coralichlamys acroporicola sp. nov. (Plate V, figs. 26, 26*a*.)

Nestling among the branches of coral a small " *Chlamys* " of very fine sculpture and somewhat irregularly shaped was found. This kind of shell has been commonly known as *Pecten madreporarum* Petit, but no such name is recorded by Sherborn in the 'Index Animalium', and apparently the name was first published by Sowerby ('Thes. Conch.' I, p. 68, pl. 14, fig. 68, 1842) for a Red Sea shell. Then Philippi (' Abbild. Beschr. Conch.' I, p. 203, pl. ii, figs. 4, 5, December, 1844) used it for a shell from Java, and later Reeve (' Conch. Icon.' VIII, pl. xxviii, sp. 117, May, 1853) figured a broader shell, also from Java.

Sowerby's figure shows a strong radial sculpture with about nine (seven in description) prominent ribs, and intervening radials with no concentric sculpture, and measuring ·80 inch by ·66 inch, *i. e.* 20 × 16 mm. The Australian species reaches 29 mm. by 24 mm. and is then somewhat irregular in shape, the posterior side being produced. The young shell is of regular *Chlamys* shape, and neat sculpture, but very soon the sculpture becomes complex and the form distorts. Beginning with a smooth umbonal area, smooth radials arise, and these later produce fine prickly scalloping and intervening radials also develop and then also become prickly, so that in the senile the ribs are very numerous and prickly and are all overrun by concentric growth ridges, these predominating at the margin. The shells are all more or less distorted and worn through their habitat in life lodged between branches of coral held by a byssus.

Genus *Volachlamys* nov.

Type: *Pecten cumingii* Reeve.

Shell of rather *Vola*-like appearance, but with both valves convex, and with subequal ears, though with Chlamydoid byssal gape and ctenolium. The surface is ribbed, the ribs smooth, the interstices striate, and no scales appear on the ribs. The edges of the valves are internally grooved to fit, but the grooves do not persist in the interior. The cardinal crura are very weak, a short slender rib running subparallel to the hinge, and a weak ridge on each side of the short broad ligamental pit ; the hinge area is obtusely striate. There is a fairly large byssal gape, and a well-marked ctenolium with strong teeth. The juvenile sculpture is very interesting, as the right valve shows a notable smooth umbonal area, while the smooth part in the left valve is restricted to a very small portion, radial ribs beginning very early. This means that a shell of 4 mm. in height would have the right valve smooth and the left valve radially ribbed, though in the adult the sculpture is practically identical in the two valves. The cross-sculpture between the ribs is not developed until a much later stage in the valves, a short space of " *Camptonectes* " sculpture intervening in the left valve only.

Volachlamys cumingii Reeve, 1853.

1853. *Pecten cumingii* Reeve, Conch. Icon. VIII, sp. 140, June: Moreton Bay, Queensland.

Hedley synonymized this with *singaporinus* Sowerby, probably following Bavay, who included *pica* Reeve (' Conch. Icon.' VIII, sp. 115, May, 1853, from New Zealand = error). The unequal ears of *singaporinus* separate that species from the true *cumingii*, which is a coastal Queensland shell; there is, however, a shell in Northern Australia, west of Torres Straits, which approximates more closely to the Singapore form.

Genus *Gloripallium* nov.

Type: *Ostrea pallium* Linné.

This species recalls the Chlamydoid series at sight, but is very distinct in its stouter build, its strong hinge and its essentially different sculpture. The very juvenile is concentrically finely striate, radials developing later with the striae persisting in the intervals. Then, upon the radials, grow regular distant fluted scales, and smooth radials appear in the interstices, the striae still continuing even when two or three radials intervene; on the left valve the sculpture is a little dissimilar in its growth though reaching the same adult appearance, all the ribs developing strong scutes which become trifold on the main ribs, the intervening minor riblets also becoming scutellate. Both valves are convex, of about the same convexity. The ears are unequal but similarly strongly scaly. The hinge is stout, the cardinal crura consisting of two very strong diverging very rugose ribs, a smaller ridge bounding the ligamental pit on each side; the pit is broad but the ligament is not very large. A definite groove appears below the cardinal crura on the outer edge of each ear, forming a tubular aperture, when the valves are closed. The auricular crura are strong interlocking ridges, a deep byssal groove concluding in the left ear with a nodulose ridge intervening with a couple of linear nodules succeeding.

Gloripallium pallium Linné, 1758.

1758. *Ostrea pallium* Linné, Syst. Nat. 10th ed., p. 697, 1st January, cited " Rumph. Mus. t. 44, figs. B. C: Gualt. Test. t. 74, fig. F; Argenv. Conch. t. 27, fig. I, and Kratzenst. Regenf. 26, t. 6, fig. 59: O. Australiore et Indico.

Accepting the first reference, the type locality would become Amboina, while Hanley (' Ipsa Linn. Conch.' p. 105, 1855) has stated that the specimen in the Linnean cabinet may be compared with fig. 167 in Sowerby's ' Thesaurus ' (I). There is a *Pecten novaeguinae* Ten-Woods (' Proc. Linn. Soc. N.S.W.' II, p. 267, May, 1878) described from Yule Island, New Guinea, which Tate (' Proc. Linn. Soc. N.S.W.' IX, ser. 2, p. 214, 1894) has determined as referable to this species.

Bavay (' Journ. de Conch.' LIII, p. 32, 25th May, 1905) reported that Reeve's *Pecten speciosus* (' Conch. Icon.' VIII, pl. xxvii, fig. 112, May, 1853; Philippine Islands) was the immature of *pallium*. The immature of the local form does not agree at all with Reeve's figure. Reeve also described a *Pecten prunum* (' Conch. Icon.' VIII, pl. xx, fig. 78, April, 1853) from Moreton Bay, which Hedley suggested in his MS. notes might be " *pallium* "; but it has eighteen ribs and larger ears, and cannot certainly be placed here.

Genus *Annachlamys* nov.

Type: *Pecten leopardus* Reeve.

Medium-sized shells, both valves convex, but somewhat flattened umbonally and spreading laterally, compressed towards the edges, gaping a little dorsad, and subequilateral and a little inequivalve, the right valve less convex than, and clasped by the left valve. The sculpture consists of few stout radials overrun by densely packed concentric striae gaining strength ventrad, the ribs themselves sometimes flattening. The ears are subequal with no byssal gape nor ctenolium, and a juvenile radial sculpture disappears at an early stage, the surface being concentrically threaded as the valves. The valves inside are ribbed in the Amusioid, or better in the Notovolid manner, and there is present on each side an auricular nodule, but no auricular crura.

The hinge shows two cardinal crura, divergent and fairly strong, but a little variable, and coarsely striate; no rims to the ligamental pit, which is rather small and broad, the ligament rather narrow.

Annachlamys leopardus Reeve, 1853.

1853. *Pecten leopardus* Reeve, Conch. Icon. VIII, sp. 145, June: Moreton Bay, Queensland.

Fifty years ago Smith (' Rep. Zool. Coll. Alert ', p. 114, 1884) recognized Reeve's *leopardus* in a shell from the Arafura Sea collected by Coppinger, and ranged as a variety *Pecten kuhnholtzi* Bernardi (' Journ. de Conch.' VIII, p. 378, pl. xiii, fig. 1, October, 1860) from New Caledonia. He also regarded the Amboina shell as a variety (*solaris* Sowerby, and Dunker, not *solaris* Born). Smith's comment reads: " It is not surprising that M. Bernardi did not recognize his shell in *P. leopardus*, considering how inadequate a description is given by Reeve." To our eyes to-day, with topotypical specimens for comparison, Reeve's figure is excellent, and the description sufficient. Bernardi's shell came from New Caledonia, and a series from that locality shows a more convex shell, with more —twenty—and narrower ribs with broader interstices, and is undoubtedly separable from the Moreton Bay shell. Bavay (' Bull. Mus. d'Hist. Nat. Paris ', 1904, p. 364) regarded *leopardus* as only a spotted variety of *flabellatus* Lamarck (' Hist. Anim. s. Vert.' VI, pt. 1, p. 172, July, 1819), which was described from unknown locality, and might even have come from West Australia, but not from Queensland. Hedley (' Proc. Roy. Geog. Soc. Austr. (S. A. Br.) ', 1916–17, ref. p. 3) later introduced *macassarensis* Chenu (' Illustr. Conch.' XXXIX, pl. xxxix, fig. 4, 1845) for the West Australian form. Chenu did not mention this species in the text, so that the name depends solely on the figure and the implied locality. Reeve ('Conch. Icon.' VIII, pl. xxiii, sp. 92, May, 1853), overlooking that name, used *solaris*, as of Born, for a species from Macassar and China. Chenu's illustration shows no superficial distinction, but Reeve's figure is more like the Queensland *leopardus* than the West Australian shell. Eliminating for the present the association with the Macassar shells, which seems unwise, the Australian specimens so far collected are separable into distinct groups. Typical specimens from Moreton Bay agree very accurately with Reeve's figure and description, and apparently the species ranges from Moreton Bay to Torres Straits. A large series collected at North-West Island, Capricorn Group, appears to differ in several details. The valves are rounded in form, more convex, the ears seem to recurve laterally and seem smaller, the ribs rather deeply cut and,

especially, the hinge is very strongly developed. A perfect specimen measures 64 mm. across and 58 mm. in height, the ears being 34 mm. across. The right valve is clasped by the left, which is faintly red spotted, the right being white. This form may be called *Annachlamys leopardus rena* subsp. nov., and it is nearer *kuhnholtzi* Bernardi, but has smaller ears and is rounder. Many small specimens are more convex and rounder still, but all have small ears and strong hinges, but most interesting is the fact that a small ctenolium can be discerned in some. Internally all the specimens are more or less yellow, some showing red blotches.

A single left valve was dredged at Station XIV, Low Isles, and it is quite unlike any of the North-West Island shells, having notable larger ears and being flatter, with stronger sculpture. The ribs are sixteen in number, regular, not flattening dorsad, and the concentric sculpture showing over the ribs from the umbo to the dorsal margin, being stronger as usual near the edge. The ears are comparatively large and flattened, the hinge weak, the cardinal crura fine and the inside white. It measures 39 mm. in height and 43 mm. in width, across the ears 29 mm. The West Australian shell is more flattened than the eastern one, the sculpture notably much stronger, the ribbing on the right (white) valve, being flattened and broadened towards the dorsal margin, the interstices being consequently narrowed and shallow; on the left valve, which is blotched with red, the ribs are stronger and more elevated and the interspaces broad, but in this valve there is an appreciably broadening, and flattening of the ribs towards the edge of the valve. The hinge is very weak, the cardinal crura very small and the interior is pure white. It is here called *Annachlamys melica* sp. nov., the type being a specimen measuring 79 mm. across by 69 mm. in height, collected by Mr. Arthur Livingstone, at Broome, North West Australia.

It may be noted that Smith ('Rep. Sci. Res. "Challenger", Zool.' XVI, p. 299, 1885) recorded "*Pecten leopardus* Reeve (var. *solaris*) from the Island of Luzon, Philippine Islands, commenting: "The typical form of this species was collected on the coast of Queensland. The variety *kuhnholtzi* is New Caledonian, and var. *solaris* has been found at Amboina (Dunker), Macassar and China (Reeve). In the 'Alert' Report I forgot to mention that in addition to the difference of colouring the typical form also presents a difference in outline. The auricles are certainly larger than in either of the varieties, and the sides are more spreading or fan-like. This variation, however, is approached by one of the specimens of var. *kuhnholtzi* in the British Museum, and I have little doubt that had I a large series for examination I should find many intermediate forms, and should also probably observe that each variety as a rule maintains its special shape."

Genus *Comptopallium* nov.

Type: *Comptopallium pauciplicatum* nov.

Shell large, longer than broad, both valves convexly flattened, the left valve flatter than the right, valves strongly ribbed; ribs elevated, composed of many finer ridges, interstices deep, wider than the ribs, a fine microscopic concentric wrinkling overrunning the ribs and crossing the interstices, becoming coarser on the ribs with age; byssal sinus small with a well-marked ctenolium with small close teeth; ears medium, subequal, with no auricular crura, but a few small nodules on edges of ears; hinge line finely strigate, cardinal crura small and the second one less than half the length of the major one, which

extends along subparallel to the hinge-line ; a third very small one nearer, but not edging the ligamental pit may be sometimes discerned ; ligamental pit short and broad. The ventral border shows internally no nodulation in the immature, but in the adult a slight margination at each side of the ribs appears. The immature is practically equilateral in the immature, but may show a little obliquity in the senile shell.

This form cannot be classed generically with *strangei*, as it is a larger shell, thinner, with a different growth throughout, the hinge line being very distinct and the ventral growth quite regular. When Mörch placed *plica* under *Dentipecten*, he located this form (as " *radula* ") under *Pecten* Klein, indicating that he had recognized the distinction.

Comptopallium pauciplicatum nov. sp.

The generic features given above may be supplemented by the following:—Coloration: the right valve is generally unspotted white, the left marked with small blotches of reddish brown, arranged in interrupted concentric rows subparallel to the ventral edge, and becoming obsolete towards the umbo ; there is a splash of colour along the dorsal lines of the ears. The ribs are constantly ten in number, whereas Linné's *O. radula* had twelve ; Bavay notes the discrepant number of ribs cited by authorities, varying from eight to as many as fourteen, but did not attempt to correlate these records with geographical data. He noted that Reeve's *P. argenteus* (' Conch. Icon.' VIII, pl. xxxv, sp. 168, August, 1853 : China Sea) was like the young of " *radula* ", and that it had ten ribs only, although the Philippine Islands " *radula* " had twelve ribs.

Commonly known as " *radula* ", it was shown eighty years ago that this was not valid, as Linné had not described it, thus : " *Ostrea radula* Linné (' Syst. Nat.' 10th ed., p. 697, January) was based on ' Rumph. Mus.', t. 44, fig. D, Radula, and ' Klein Ostr.', t. 9, fig. 34, from O. Indico. " The indeterminate description read, " O. testa radiis 12 convexis: striis decussatis crenatis, auriculis aequalibus ". The figure of Rumph is not even of a scallop, but is of *Lima lima* (Auct.).

Hanley (' Ipsa Linn. Conch.' p. 104, 1855) pointed this out, but left the matter : " In the tenth edition of the ' Systema ', Rumphius, pl. 44, fig. D, and its copy in Klein (pl. 9, fig. 34) were inadvertently cited for a species (' radiis 12 '), to which they bear no resemblance ; the references were removed in the final edition to *Ostrea lima,* and the present citation substituted (M.L.U. 525, n. 105*). The name *radula,* though appertaining properly to the former figures only, was still retained, and appended falsely to the changed letters (' Rumph. Mus.' t. 44, figs. A, B, Radula)." Be it noted that neither of Rumph's figures A, B, show "12 radiis ", each giving more—A, 14 or 15, and B, 20—and while the former is like the " *radula* ", the latter is of the " *pallium* " style. Hence, *radula* cannot be preserved for the Scallop in any manner, and the Queensland shell hitherto so-called is named as above.

Genus *Decatopecten.*

1839. *Decatopecten* Sowerby, Conch. Man. 1st ed., p. 37, *ex* Rüppell MS.
Haplotype : *Pecten plica* Linn., fig. 172 (Expl. p. 121).

1840. *Decadopecten* Swainson, Treat. Malac. p. 388, May, *ex* Rüppell MS.
Haplotype *D. plicata* Sw., for Sow. Man. fig. 172.

1817. *Pallium* Schumacher, Essai nouv. Syst Test. pp. 44, 120.
Haplotype *Pallium striatum,* pl. iv, fig. 4, cites Chemn. VII, p. 292, tab. 62, fig. 598 *a, b* (*Pecten plicatus*).

Not *Pallium* Schroeter 1802, *fide* Cox (Proc. Mal. Soc. (Lond.) XVIII, p. 201, 1929).

1847. *Pallium* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 200, November, *ex* Martini, 1773: Schum., 1817. Orthotype: *Pecten plica.*

1847. *Dentipecten* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 300, November, cited as synonym of *Pallium*: "*ex* Rüppell, 183?".

1853. *Dentipecten* Mörch, Cat. Conch. Yoldi, II, p. 58, April, *ex* "Rüppel MS.". Haplotype: *P. plica* L. = *plicatus* Ch.

Shell small to large, both valves flattened, left valve less convex than right, much higher than broad, strongly ribbed. Ribs narrow, rather distant, interstices as broad as ribs, ribs finely radially subribbed and finely concentrically striate, intervals similarly striate. Ears medium, subequal, with a small byssal sinus and ctenolium. No auricular crura but edges of ears nodulose, cardinal crura distinct, two in number, short but distinctly strigate. Ligamental pit triangular, rather broad but ligament narrow. Edges of valves showing internally little ridges, enabling the valves to fit tightly ventrad, but sides a little open.

Sowerby's figure shows a small shell with three very crass teeth on each side of the hinge, while Schumacher had also figured the hinge with three to five similar very heavy teeth.

Dall dismissed this: "The development of the cardinal grooves on the inside of the hinge (stressed so much by Schumacher and others) is a function of the short hinge-line and is in itself of little systematic importance." On the contrary, it appears to be of the greatest value as indicating the development of *Spondylus* and is definitely not due to the shortening of the hinge at all, since throughout the family many species with even shorter hinge lines have not produced teeth at all.

Decatopecten strangei Reeve, 1852.

1852. *Pecten strangei* Reeve, Conch. Icon. VIII, pl. iv, sp. 22, November: Moreton Bay, Queensland.

From the figures in the 'Conch. Icon.' the following species should be classed together: *Pecten velutinus* (sp. 12: Macassar Island, of Celebes), *Pecten plica* (sp. 16: China, Ceylon) and *Pecten subplicatus* (sp. 17: Island of Corrigidor, Bay of Manila, Philippine Islands). *Ostrea plica* Linné ('Syst. Nat.' 10th ed., p. 697, January, 1758) is thus described: "O. testa radiis 6 convexis laeviusculis, decussato-striata. *Rumph. mus. t.* 44, *f.* o. Pallium maculatum. *Argenv. conch., t.* 27, *f.* c. *Habitat in* O. Indico."

From the figure of Rumph the restricted habitat should be Amboina, but Sowerby ('Thes. Conch.' I, p. 65, pl. xx, figs. 237–239, 1842) used *P. plica* for a species from Nicobar, Ceylon and China, and introduced *P. subplicatus* (p. 64, pl. xiii, fig. 37, and pl. xiv, figs. 72, 73, 81) for the Amboina shell. On the previous page he had named *P. velutinus* (sp. 63, pl. xiii, fig. 31) on a specimen from Macassar collected by Mr. Hinds. Fig. 238 shows the characteristic strong teeth of "*plica*" so unlike the cardinal crura of any other "*Pecten*", while the figs. 37, 73, 31 all portray strong cardinal crura of the conventional form. Sowerby's fig. 37 is in closer agreement with the Rumphian figure than are his figs. 237–239, and Argenville's figure is also similar to that of Rumphius. From this it would appear that Linné's *plica* must be restricted to Amboina, and would be undoubtedly the shell named *subplicatus* by Sowerby. Schumacher introduced the genus *Pallium* for the commonly accepted "*plica*" with strong teeth in the hinge, and named it *Pallium striatum*, basing his species on Chemn. VII, p. 292, tab. 62, fig. 598, *a*, *b* (*Pecten plicatus*), from the East Indian seas, especially noting that Linné's *Ostrea plica* did not mention the

characteristic hinge-teeth and might therefore be different. As the type of *Decatopecten* Sowerby gave *Pecten plica* Linn., but with a fig. 172 which shows the strongly toothed shell. Thus the combination *Decatopecten striatus* Schumacher would become the name of the shell commonly known as *Pecten plica* Linné, and *Decatopecten plica* Linné would be the shell named *Pecten subplicatus* Sowerby. These species do not appear to occur in Australia, the species *Pecten strangei* Reeve ranging from Moreton Bay to Torres Straits, Queensland, and probably also along the north coast.

An immature specimen from Low Isles, 9–12 fathoms, is thin, with the ears comparatively large, the shells almost as broad as high, the major ribs undulatingly separated. There is a distinct ctenolium, but very slight byssal gape. The post-umbonal sculpture consists of very fine concentric striae, followed later by the development of a fine radial ribbing. The ribs become larger with age, the intervals very deep, about the width of the ribs, and fine riblets appear in the interstices as well as on the ribs, the microscopic concentric striae still, however, persisting. As a senile feature the edges of the valves turn inwards, forming a dorsal shelf; internally there is a series of elevated elongated nodules at each side of each rib, while a couple of similar auricular nodules appear, but no auricular crura. The hinge develops slowly in the normal manner, a long cardinal crura subparallel to the hinge line, and a shorter one subparallel to it, a coarse denticulation overriding both. This is quite unlike the strong teeth of the "*plica*" series, and must be differentiated by means of a name, *Edentiplica.*

Genus *Complicachlamys* nov.

Type: *C. wardiana* sp. nov.

This genus is well characterized by its shape, tenuity and sculpture, the hinge features also distinguishing it from other strongly ribbed groups. It has a wide range, from Mauritius to the China Sea.

Shell small, longer than broad, thin, subequilateral, ears very unequal, sculptured with strong ribs, these being stronger and more distant in the left valve, which is also more flattened than the right, though neither valve is very convex.

The initial shell is smooth, but very early ribs are developed, accompanied by a fine radial, sometimes oblique scratching, which is succeeded by a definite close radial ribbing covering the whole surface; major ribs and intervals alike, the interstices of these minor ribs being closely scalloped, producing a honeycomb effect. The anterior ears are large, the posterior ears very small, the byssal sinus large and the ctenolium strong, the teeth curved. There are no auricular crura, the external ribbing of the ears showing through. The hinge line is delicate, the cardinal crura thin and the denticulation obsolete; the ligamental pit broad and deep. Internally the external ribs show through, but the edges of the valves are thin and only slightly sinuate.

Complicachlamys wardiana sp. nov. (Plate V, figs. 25, 25*a*.)

There is great difficulty in this little group, as Melvill and Standen recorded *crouchi* and *dringi* as separate species from Queensland. Odhner included *fulvicostatus* and *dringi* as separate species from North-West Australia. Lynge (p. 156) and Bavay synonymized *dringi* with *fulvicostatus*, and added *luculentus.*

Pecten crouchi was described by Smith ('Ann. Mag. Nat. Hist.' IX, ser. vi, p. 255, fig. in text, March, 1892) from Mauritius with very unequal auricles and nine ribs, each bearing seven raised lines. The name can be dismissed at once from the Australian list, as *crouchi* can only be regarded as a geographical representative of *dringi*, and therefore could not occur in Queensland.

Pecten dringi was introduced by Reeve forty years previously ('Conch. Icon.' VIII, pl. xxxiii, sp. and fig. 152, August, 1853) for a species collected by Dring at Bathurst Island, north-west coast of Australia. The species, which Odhner added from north-west Australia, was described by Adams and Reeve (*Pecten fulvicostatus*, 'Zool. Voy. "Samarang", Mollusca', p. 74, pl. xxi, fig. 11, 1850) from the Sooloo Archipelago, and the figure in shape and ribbing does not agree with Australian specimens. Bavay's addition of *luculentus* is correct, as Reeve ('Conch. Icon.' VIII, pl. xvi, sp. and fig. 59, February, 1853) had proposed *Pecten luculenta* from Bathurst Island, North Australia, and apparently overlooked it, when a few months later he named *dringi* from the same locality. In connection with the latter Reeve remarked "Colouring extremely variable", but the shape also varies and thus accounts for the attempts to record two species where only one exists. A fair series of specimens is available from Darwin, practically the type locality of *luculenta* and *dringi*, and others from North-West Australia, and while these show variation they are separable from the Queensland specimens, so the latter are named as above. The type is a specimen collected by Mr. Melbourne Ward at Hayman Island, Whitsunday Passage, measuring 29·5 mm. long by 25 mm. broad. A series of *luculenta* = *dringi* from Broome, North-West Australia, ranges up to 60 mm. long by 50 mm. broad. A shell from the latter series measuring 29 mm. long by 25 mm. broad has been compared with the Hayman Island type, and it has the ribs much more elevated, the intervals consequently deeper and wider and more marked; this is still more noticeable in the left valve, where the median riblet of each rib has broadened and become more distinct. The Queensland shell ranges along the coast line of Queensland from Cape York to Port Curtis, an odd specimen occurring at Low Isles.

It may be possible that the species here distinguished can be degraded to the rank of geographical races or subspecies, but the experience gained in the study of marine molluscs does not make this a desirable course without a very complete knowledge of the animals concerned. Therefore we may allow at present:

Complicachlamys fulvicostata A. Adams and Reeve, 1850. Sooloo Archipelago.

Complicachlamys luculenta Reeve, February, 1853 = *dringi* Reeve, August, 1853. North and North-West Australia.

Complicachlamys crouchi Smith, 1892. Mauritius.

Complicachlamys wardiana Iredale, 1938. Queensland.

Genus *Minnivola* nov.

Type: *M. isomeres* sp. nov.

Shell small, valves very inequivalve, left valve flat or concave, right very convex; ears very large, subequal but with right anterior ear Chlamydoid and bearing ctenolium, posterior ears abnormally large. The sculpture consists of deeply cut radials, rather broad, with narrower interstices on the right valve, those on the left valve being narrow, with broader interstices. In the right valve the interstices appear to be smooth, neither

striate nor sculptured, but in the left there is a curious interstitial pustulation. As noted above, the left valve has the posterior ear larger than the anterior, which is concave ; fine radials appear on all ears. The hinge-line is very weak, the cardinal crura almost obsolete and striae practically missing ; the ligament rather large in a deep narrow ligamental pit.

Minnivola isomeres sp. nov.

Hedley included *Pecten pyxidatus* Born in the Queensland list, while Lynge (p. 153) recorded it from the Gulf of Siam, as common in 6–30 fathoms, citing as a synonym, *Pecten crebricostatus* Philippi (' Abbild. Beschr. Conch.' I, p. 100 (Pecten, p. 2), pl. i, fig. 2, January, 1844) from China. The description and figure of the latter are not much like those of the Queensland shell, especially as regards the depth.

A couple of young left valves were picked out of the Low Isles dredging in 9–12 fathoms, and in the Australian Museum there are valves from Mapoon, Queensland, 10 fathoms, from Port Curtis, Queensland, a complete specimen and some odd valves from Murray Island, 4–14 fathoms, and a larger complete shell from Lady Elliott Island, South Queensland, which is here described as type of the new species.

The generic characters given above relate to this specimen, which is whitish, densely mottled with deep pink on the ribs ventrally, the earlier portion of the shell and the interstices being unspotted. Its measurements are : Height 29 mm., breadth 32 mm., depth 10 mm. The number of ribs on the left valve is nineteen or twenty, on the right twenty-two to twenty-four, but there is a strong tendency to break up, more than thirty being counted on the Murray Island specimen, which moreover has the right valve unspotted and the left marbled with brownish red, umbones white.

Genus *Notovola*.

1926. *Notovola* Finlay, Trans. New Zeal. Inst. LVII, p. 451, 23rd December.
Haplotype : *Pecten novae-zealandiae* Reeve.

The shells of this group are large, very inequivalve, left valve flat or concave, right valve convex, broader than high, ears equal, large, with no byssal sinus or ctenolium, valves gaping a little at sides dorsad. The sculpture consists of broad non-scaly ribs, the interior also showing strong ribbing. The ligamental pit is broad and there are three cardinal crura on each side, serrate.

The left valve is clasped by the right and the radial ribs on it are narrow, the intervals much broader and both are overridden by fine concentric threads very closely packed ; the right valve has broad flattened ribs, the interspaces being narrower, and there are no overriding striae until the shell reaches a large size. In some cases, however, the ribs of the right valve are cut into two or even three parts longitudinally and also the overriding threads appear at an early stage. The initial umbonal portion of the shell is smooth and even in the left valve convex.

The generic name *Pecten* cannot be used from Osbeck as Grant and Gale (' Mem. San Diego Soc. Nat. Hist.' I, p. 154, 3rd November, 1931) have suggested, as the wording does not indicate a *Pecten* at all, but definitely suggests a *Spondylus*. " With the cable we pulled up a piece of coral, on which a red shell (*Pecten adscensionis*) was growing, which on its valves represented many branches." Scallops do not commonly grow on pieces of

coral, neither do they have branches on their valves, whereas *Spondylus* does both, and is, moreover, very commonly red. Grant and Gale observe, " As *Pecten* had long been in use for scallop shells, even in Osbeck's time ", but Linné did not use *Pecten*, and Chemnitz in 1784 used *Pecten*, *Pallium*, *Amusium*, *Pera*, *Perna*, *Pseud-amusium* and *Pyxis* for a series of scallops, showing no restricted usage.

Notovola fumata Reeve, 1852.

1852. *Pecten fumatus* Reeve, Conch. Icon. VIII, pl. vii, sp. 32, November : Sydney, Australia.
1852. *Pecten fuscus* Reeve, Conch. Icon. VIII, pl. viii, sp. 35, November : Moreton Bay.
1852. *Pecten modestus* Reeve, Conch. Icon. VIII, pl. xi, sp. 41, December : Moreton Bay.

Hedley included *Pecten medius* Lamarck in the Queensland list, but Lamarck (' Hist. Anim. s. Vert.' VI, pt. 1, p. 163, July, 1819) gave no locality for his species, and he had no Sydney shells. I rejected the name, as it was preoccupied by Bosc, but Cox (' Proc. Mal. Soc. (Lond.),' XVIII, pp. 165–209, July, 1929) has dissented, stating that *Pecten medius* Bosc was merely *Ostrea media* Gmelin, and therefore had no validity. As Bosc does not quote Gmelin, that conclusion is not unarguable, but it does not in any sense affect the nomination of the Sydney species. Cox then adds : " If the Australasian forms belong to more than one species, *P. medius* should presumably be used for *P. novae-zealandiae*." There is no doubt among Australasian malacologists, who have handled these shells in long series, that more than one species is represented here, while the presumption that *P. medius* is applicable to the New Zealand shell is ill-founded. Lamarck had few New Zealand shells, whereas he had many Australian, and when the type can be studied by someone familiar with Australasian material it may prove to be of local origin. In the meantime the name must be rejected, as there is absolutely nothing in the description whereby it can be identified.

The Queensland specimens are very like those from Sydney, so that at present the name *fumata* may be used. So far it is only known from southern Queensland, ranging as far north as Keppel Bay only. About that locality only small specimens have occurred as yet.

Pecten pulchella.

There is a mystery about this name, which may be solved soon by the collection of material at the supposed type locality, and it may turn out that this is a foreign shell and that the locality is incorrect.

Reeve described *Pecten pulchella* (' Conch. Icon.' VIII, pl. xxxii, sp. 142, June, 1853) from Moreton Bay, Australia, collected by Strange, and this species has not since been recognized. Hedley, in his MS., placed it next to *Pecten fumatus* Reeve, querying it as the young, but the description shows that it is not a *Notovola*, and therefore cannot be placed there. Finlay (' Trans. New Zeal. Inst.' LVII, 1926, p. 529, 19th January, 1927) proposed a new name for the species, *Chlamys moretonicus*, on account of the prior *P. pulchellus* Nilsson, 1827. It is not much like a *Chlamys* either, the description reading very similarly to that of *Pecten leopardus* Reeve ; but unfortunately the latter species appears on the same plate and therefore it should be different.

Genus *Excellichlamys* nov.

Type : *Pecten spectabilis* Reeve.

This very beautiful "*Pecten*" is differentiated from any other Australian group by several distinct features. The general appearance is that of "*Pecten*" as contrasted with "*Chlamys*", its strong sculpture recalling that of *Gloripallium.*

Shell rather small, inequivalve, a little inequilateral, the right valve convex, left valve flat, ears large and unequal. The sculpture consists of rounded raised ribs, with deep interstices, twelve or so in number, with curious sculpture. The umbones are smooth, then arise radials, which later produce scales which flatten into bodies closely appressed, giving the appearance of coarse roping ; the ribs on the right valve are regular in size, but on the left broad raised ribs alternate with narrower lower ones ; the interstices are finely scabrous ; with age scaly radial threads arise in these hollows. The ears are sculptured with scaly radials and there is a small byssal notch with a seven-toothed ctenolium. The hinge shows a small triangular ligament and the hinge line is finely crenulate throughout, but there are no cardinal crura present. The edges of the ears are coarsely denticulate and fit tightly.

Excellichlamys spectabilis Reeve, 1853.

1853. *Pecten spectabilis* Reeve, Conch. Icon. VIII, pl. xxix, sp. 128, June : Habitat ?

Our shells agree well with Reeve's figure, but Bavay regarded *spectabilis* Reeve as a synonym of *histrionicus* Gmelin, including also thereunder *parvus* Sowerby. Gmelin (' Syst. Nat.', VI, p. 3326, 1791) gave four references for his species, viz. ' Bonann. recr. and Mus. Kirch.' II, fig. 14 ; ' Knorr. Vergn.' IV, t. 12, fig. 3 ; ' v. Born, Mus. Caes. Vindob. test.' p. 97, vign. fig. 6, and t. 6, fig. 3 ; ' Chemn. Conch.' VII, t. 65, fig. 614 ; and the conventional recognition of his species does not agree with Reeve's species. Sowerby named *Pecten parvus* (' Proc. Zool. Soc. (Lond.)' 1835, p. 110, October 9 ; ' Thes. Conch.' I, p. 67, pl. xx, figs. 227–28, 1842 ; Lord Hood's Island, Galapagos) with very unequal ears, and which certainly is not conspecific with *spectabilis.* Dautzenberg and Bavay (' Siboga-Expeditie,' LXI, mon. liii*b*, Lamell. (p. 23), December, 1911), also made *parvus* a variety of *histrionicus*, while Lynge (p. 157) attempted to revive *Pallium sannionis* Chemnitz (VII, p. 313, pl. 65, fig. 614, 1784), a non-binomial name, to replace Reeve's *spectabilis*, remarking that Gmelin's *histrionicus* was scarcely applicable.

Genus *Bractechlamys* nov.

Type : *B. evecta* sp. nov.

Shell small, somewhat strongly convex, strongly ribbed ; valves subequal, one valve usually plain, the other coloured and blotched, but sometimes both valves are coloured ; valves subequilateral, stout, ears subequal.

The apex is smooth, but soon plain radial ribs arise, and these develop into broad, rounded, compound ribs, with narrower deep intervals. The early shell is covered with very fine, practically microscopic, concentric threads, quite unlike the longitudinal scratching of *Complicachlamys*, and like the fine sculpture of *Juxtamusium*, than which

the adult shell could not be more unlike. This fine sculpture persists on the top of the major compound ribs, but the edges and interstices produce a series of radial rows of minute scallops. There is a small byssal sinus and a remnant of a ctenolium, which sometimes disappears altogether. There are no auricular crura, but a nodule appears at the base of the posterior ear. The hinge line is very stout, three well-marked cardinal crura being present and all strongly denticulate ; the ligamental pit broad and short, the ligament itself narrow. The ventral edges of the valves thin and strongly clasping, in accord with the external ribbing.

Bractechlamys evecta sp. nov. (Plate V, figs. 20, 20*a*.)

A very pretty little scallop occurred among the dredgings and had previously been secured at Michaelmas Cay. It had most similarity to *vexillum* Reeve (' Conch. Icon.' VIII, pl. xxvii, fig. 114*b*, May, 1853 : no locality) and to *distans* Lamarck as figured by Reeve (pl. xiii, fig. 49, February, 1853 : Philippines). The latter name was replaced by Fischer (' Journ. de Conch.' VII, p. 340, June, 1859) by *Pecten janus* ex Montrouzier MS. for a New Caledonian species. The availability of the new name for the Queensland shell is negatived by its invalidity, there being a prior *Pecten janus* Münster (' Goldfuss, Petref German.' II (4), 1833, p. 62. *fide* C.D.S.) so that the local shell is here described.

Shell somewhat convex, small, inequivalve, almost equilateral, ears unequal ; sculpture of a few strong ribs ; coloration of one valve brownish with white blotches irregularly arranged concentrically, coloration of the other valve uniformly pale yellow. Hinge with strong lateral teeth, striate, ligamental pit broadly triangular.

Sometimes the right valve is coloured, sometimes the left, at times both ; one weaker than the other, as if the shell had altered its position. The colouring recalls that of *Pecten aurantiacum* A. Adams and Reeve (' Zool. Voy. "Samarang", Mollusca ', p. 74, pl. xxi, fig. 12, August, 1850) but that species has more ribs.

It appears to be constantly smaller than the unnamed New Caledonian shell, which is generally darker coloured, with a rougher sculpture, a stronger hinge and the ctenolium obsolete. The type, from Station XIV, measures 35 mm. in height and 30 mm. in breadth.

Genus *Corymbichlamys* nov.

Type : *Chlamys corymbiatus* Hedley.

Shell subcircular, subequivalve, almost equilateral, both valves convex, ears unequal, sculpture complex and distinctive. The sculpture consists of strong elevated radial ribs with deep interstices, the ribs ornamented with raised nodules which are flanked by projecting spurs, the intervals between the ribs being latticed with strong distant threads. The umbones show radials at an early stage with a distinct concentric striation, which becomes stronger as the ribs develop, the complex surface sculpture accruing later. Although both valves are convex, the left is slightly less so than the right. The ears are of the " *Chlamys* " type, but the convexity of the valves masks their disparity, which is well pronounced ; they are strongly sculptured, the byssal notch being well marked, the ctenolium with four to six strong teeth. The ears gape a little at the hinge junction and the right hinge line overlaps a little. The hinge itself is very strong, the ligament large and triangular, cardinal crura elevated and markedly denticulate.

Corymbichlamys corymbiata Hedley, 1909.

1909. *Chlamys corymbiatus* Hedley, Proc. Linn. Soc. N.S.W. XXXIV, p. 423, pl. xxxvi, figs. 1–4, 3rd December : Hope Islands, Queensland.

This beautiful little species is like no other Queensland scallop, and the complex sculpture, peculiar form and extraordinaily developed hinge demand generic segregation. It does not seem to be known from New Caledonia yet, though in addition to the type locality, it has been dredged at Low Isles, Michaelmas Cay, Lindeman Island, Whitsunday Passage and North-West Island, in the Capricorn Group to the south and from Albany Passage, and even Mapoon to the north, thus giving it an extensive Queensland range.

Genus *Juxtamusium* nov.

Type : *J. oblectatum* sp. nov. (Plate V, figs. 27, 27*a*.)

Smith (' Fauna Maldive and Laccadive Arch.' II, p. 622, pl. xxvi, figs. 19, 20, 1904) described a *Pecten maldivensis* which Hedley added to the Queensland list. Hedley's species is here described as new, and the characters are much nearer those of *Amusium* than of *Pecten*, and therefore a new generic name is proposed.

Shell subcircular, thin, compressed, equivalve, almost equilateral, gaping a little at sides, ears large, unequal.

The surface is finely striate radially on the right valve, which is coloured, but completely overridden by very fine, closely-set, concentric striae ; the left valve is uniformly pale and the radials are practically obsolete, while the concentric striae are microscopic. Internally the edge is closely ribbed, but the ribs do not extend far into the valve. Hinge folded, but striae missing, the ligamental groove triangular, but the ligament itself linear. The type from Station XVI measures 22·5 mm. in height and 22 mm. in breadth, the depth of the conjoined valves being only 6 mm.

Family Amusiidae.

The typical species of this family are large, flattened, circular, smooth shells with widely-gaping sides, small subequal ears, and ribbing interiorly.

Superficially, these shells look like " *Pectens* ", and the umbones of many *Pectens* are smooth, like the adult Amusioids, yet anatomists have determined the animal as differing. Probably the variation is not greater than that of some other scallops which have not been compared.

The small thin shells, from deeper water, which have been associated here, may have nothing much to do with the typical shells, being merely swimming " *Pectens* " derived from different sources.

Genus *Amusium*.

1798. *Amusium* Bolten, Mus. Bolten, pt. II, p. 165, September.
Tautotype : *A. pleuronectes* Bolten = Linné.
1840. *Pleuronectia* Swainson, Treat. Malac. p. 388, May.
Haplotype : *P. laevigata* Sw. for En. Meth. 208, fig. 3 = *O. pleuronectes* Linné.

The shining subglobular "*Pectens*" with their smooth surfaces of different contrasting coloration are well known, but that their animal is so very different comes as a surprise

as superficially there is no feature of commanding importance. The corollary seems to indicate the re-investigation of other Pectinoid molluscs, with probably as astonishing results.

Shell is nearly circular with small subequal ears and smooth surface, one valve of a dark colour, the other white. The valves touch ventrally, but gape widely at sides. The hinge is truly Pectinid, the cardinal crura long, thin, and very weakly denticulate. Just below the junction of the ears, internally there are strong nodules, apparently swimming aids. Internally ribs radiate to the edges, becoming obsolete umbonad. The muscle scar is very large.

At sight this is merely a *Pecten* which continually swims.

Amusium pleuronectes Linné, 1758.

1758. *Ostrea pleuronectes* Linné, Syst. Nat. 10th ed., p. 696, 1st January. 1st ref. Bonan, recr. 2, fig. 354; 2nd ref. Rumph. Mus. t. 45, fig. A. B.; 3rd ref. Gualt. Test. t. 73, fig. B; 4th ref., Argenv. Conch. t. 27, fig. G; 5th ref., Klein. Ostr. t. 9, fig. 30: " in Indiis "=Amboina.
1798. *Amusium magneticum* Bolten, Mus. Bolten, pt. II, p. 165, September, new name for *Ostrea pleuronectes* Gmelin.
1840. *Pleuronectia laevigata* Swainson, Treat. Malac. p. 388, May, for En. Meth. 208, fig. 3: No locality.

Smith (' Rep. Sci. Res. Challenger, Zool.' XVI. p. 308, 1885) observed: " The Philippine specimens of this well-known species are like that figured in Reeve's work (' Conch. Icon.' VIII, pl. xiii, fig. 48, 1853: China), but those from the North Australian region have the coloured valve curiously ornamented with angular brown markings, disposed somewhat regularly in radiating series, and towards the umbones the minute white dots which are usually noticeable are arranged in rays also." Dredged at Low Isles.

Lynge (p. 158), under *Amussium pleuronectes* L. commented: " The number of the internal ribs in the valves varies greatly, therefore *Amussium balloti* Bernardi can scarcely be maintained as a distinct species." Lamy immediately pointed out the error, as Bernardi's species was not referable to the *pleuronectes* series, but belonged to the *japonicus* group, as shown by Bernardi's description and figure.

Amusium balloti Bernardi, 1861.

1861. *Pecten balloti* Bernardi, Journ. de Conch. IX, p. 46, pl. i, fig. 1, 1st January: New Caledonia.

Hedley allowed *Amusium japonicum* Gmelin in the Queensland list, but Gmelin's *Ostrea japonica* (' Syst. Nat.' VI, p. 3317, 1791) was based on ' Chemn. Conch.' VII, t. 62, fig. 596—obviously a Japanese shell.

Bernardi differentiated the New Caledonian shell as above, noting distinction in the number of the internal ribs as follows:

Pecten japonicus,	upper valve	38–40 ribs;	lower valve	50–52 ribs.
balloti	,,	35–36 ,,	,,	42–44 ,,
pleuronectes	,,	23–24 ,,	,,	23–24 ,,

Australian specimens appear to have the small ears shown in Bernardi's figure, and also the radial colour markings of the juvenile shell, while they have less than thirty-five ribs in the upper valve, but more than forty-four in the lower. A series from the dredgings in Sydney Harbour by the " Triton ", collected by Captain Comtesse and Mr. E. F. Nash, range up to 140 mm. in height, and 135 mm. in width and this is a lower

valve with forty-five to forty-six ribs. There is on record a *Pecten* (*Amusium*) *milne-edwardsi* Gregorio (' Nat. Sicil.' III, p. 133, 1884) from New Caledonia, whose description is not available at present.

Smith (' Rep. Sci. Res. Challenger Zool.' XVI, pp. 294 *et seq.*, 1885) added three species as follows :

P. 303, *Pecten murrayi*, pl. xxii, figs. 1, 1*a*. Station 184, east of Cape York, North Australia, in 1400 fathoms.

P. 311, *Amussium torresi*, pl. xxiii, figs. 3, 3*b*. Station 185B, east of Cape York, North Australia, in 155 fathoms.

P. 312, *Amussium scitulum*, pl. xxiii, figs. 4, 4*b*. Station 188, south of New Guinea, in 28 fathoms.

Hedley left the two latter under *Amusium*, but the first-named he transferred to *Cyclopecten* when publishing his Queensland list. The continuity of the posterior auricles with the sides, the small anterior auricles, the very compressed shell amply distinguish the species from the type of *Cyclopecten*, so that the new generic name, *Catillopecten* is provided for Smith's *Pecten murrayi*. The small Amusioid species are obviously not congeneric with the huge type of *Amusium*, and may prove specifically identical when series are available, or perhaps bathymetric representatives.

Genus *Glyptamusium* nov.

Type: *Amussium torresi* Smith.

In the "Challenger" Report Smith described *A. torresi* (' Rep. Zool. Challenger ', XIII, p. 311, pl. xxiii, figs. 3, 3*b*, 1885) from Station 185B, east of Cape York, North Australia, in 155 fathoms. This is a small species, differing from *Amusium* in having the exterior sculpture with concentric lirae, being thin, with the valves compressed and scarcely gaping, the ears comparatively large, the interior of the valves with a few lirae only.

Genus *Catillopecten* nov.

Type: *Pecten murrayi* Smith.

This little species, dredged from 1400 fathoms at Station 184, east of Cape York (' Rep. Zool. Challenger ', XIII, p. 303, pl. xxii, figs, 1, 1*a*, 1885) is made the type of a new genus, as it is quite unlike any of the shallow water forms, being subcircular, compressed, inequivalve, very thin, without radial sculpture, either inside or out, and with unequal ears. The concentric lirae vary in strength on the valves, while Smith stated "it was slightly nacreous within".

The members of this family collected at Low Isles read :

Mimachlamys deliciosa Iredale. Stations XVII, XIV.
M. gavena Iredale. 9–12 fathoms. Shore.
M. subgloriosa Iredale. 9–12 fathoms.
M. ellochena Iredale. Station XVII.
M. grossiana Iredale. 9–12 fathoms.
Coralichlamys acroporicola Iredale. Shore, 9–12 fathoms.
Volachlamys cumingii Reeve. 9–12 fathoms.

Gloripallium pallium Linné. Shore.
Annachlamys leopardus Reeve. Stations XIV, XVII.
Comptopallium pauciplicatum Iredale. Shore, Station XIX.
Decatopecten strangei Reeve. 9–12 fathoms, Stations XIII, VIII.
Complicachlamys wardiana Iredale. 9–12 fathoms.
Minnivola isomeres Iredale. 9–12 fathoms.
Excellichlamys spectabilis Reeve. 9–12 fathoms, Stations XVII, XIV.
Bractechlamys evecta Iredale. 9–12 fathoms, Stations XIV, XVII, XIX, XVI, XXI.
Corymbichlamys corymbiata Hedley. 9–12 fathoms, Stations XIV, XIII, VIII.
Juxtamusium oblectatum Iredale. Stations XIV, XXII, XXI, XVI.
Amusium pleuronectes Linné. 9–12 fathoms, Stations VIII, XVI.

This series includes species otherwise restricted to the mainland and species distinctive of coral reefs ; while some of the dredged forms are not yet definitely referable to either faunula. Thus, along the coast from Moreton Bay to Torres Straits *Annachlamys leopardus* occurs, the representative species in North and North-West Australia. A single valve occurred at Station XIV, *i. e.* south-east of Lizard Island, another mixed station. Otherwise it was not secured at Michaelmas Cay, while a distinct species was dredged at North-West Island in the Capricorn Group, and another form recurs at New Caledonia. *Complicachlamys wardiana* also ranges up the Queensland coast from Port Curtis to Cape York, and a different form is found in North and North-West Australia. One specimen and some valves were dredged in 9–12 fathoms off Low Isles, and it has occurred at North-West Island, but is not recorded from New Caledonia and was not collected at Michaelmas Cay. Perhaps a more striking illustration would be the two species of *Amusium*, *japonicum* in the form of *balloti* from New Caledonia occurring in South Queensland and off the coast of New South Wales, and *pleuronectes* off the reef in North Queensland. On the other hand, we find such species as "*Chlamys pallium*" ranging through the western Pacific islands and on the Barrier Reef, but so far from none of the mainland localities searched. With it might be bracketed *Excellichlamys spectabilis*, which also has not yet been recorded from the mainland, but which occurred at Low Isles and other reefs, but no specimens are at hand from the Capricorn Group. Although these species may later be found to transgress the narrow limits here given, the broad underlying principle will undoubtedly be confirmed.

Family Spondylidae.

This family includes all the well-known shells called Thorny-Oysters, but which are really very closely related to the Scallops, and most authors have placed them in that connection. Indeed, recently, from anatomical investigation, they have even been placed in the same family. This degradation is not, however, in accordance with natural facts, as the members of each family are well distinguished, and have been for geological ages. This differentiation in age-time is of more importance than crude anatomical data of a general nature not well understood by anatomists, as admitted by themselves. Watson ('Proc. Mal. Soc. (Lond.)' XIX, pp. 25–31, 1930) has utilized a family Pectinidae, and has separated it into four subfamilies : Amusiinae, Pectininae, Spondylinae and Plicatulinae. An earlier anatomical worker had suggested the inclusion of *Plicatula* in the Amusiinae, which indicates the discordant nature of anatomical results.

On other grounds, were these groups amalgamated, the family name would become Spondylidae, as *Spondylus* was separated by Linné before *Pecten* came into use for the Scallops. As there is no confusion possible in the shells of *Spondylus* (s.l.) and *Pecten* (s.l.) their separation, on geological grounds alone, is imperative, with family rank.

Genus *Spondylus*.

1758. *Spondylus* Linné, Syst. Nat. 10th ed., p. 690, 1st January.
Logotype: Anton, Verz. Conch. 1839, p. 19, October, "1838". *Spondylus gaedaropus* Linné.

Fulton ('Journ. Conch.' XIV, pp. 331–338, 353–362, 1915) has given us a review of the species as known from Museum specimens and collections, but it may not represent the forms as they occur in nature. There is a superficial resemblance in all the species, but, in Australian waters alone, three rather distinct series can be distinguished, and these may be regarded as subgenera, as follows :

Shell stout, large, sculpture prickly, lower umbonal area large, hinge teeth large, hinge line coarsely denticulate . . . . *Lanilda.*
Shell thin, large, long spines, lower umbonal area small, hinge teeth small, hinge line finely denticulate . . . . *Sponvola.*
Shell rather thin, small, smooth, lower umbonal area very large, hinge teeth small, hinge line small and roughly denticulate . . . . . . *Eltopera.*

It is possible that many groups may be separated later, as Fulton grouped the species in many sections, using symbols, but giving no definitions of the groupings. As geographical limits were ignored the associations are of little use to extralimital workers. Thus "Group A" begins with *S. gaederopus* Linné, from the Mediterranean Sea, and this is succeeded by *S. violacescens* Lamarck, from "Australia (Chenu)". Lamarck had particularized the latter species from King George's Sound, West Australia, and West Australian shells appear to represent the species *tenellus* from East Australia, which Fulton placed at the head of his "Group K".

While Fulton had access to much material he had practically speaking no Australian shells, so that the catalogue is not of much help locally.

Again, although shells of *Spondylus* look very nice when cleaned up and hand picked, they have very little attraction in the field, the ones most frequently seen on the coast line and reefs between tide-marks being covered with growth and with their spines worn and broken, so that they escape collection save by the enthusiast. Then, they are difficult to determine, so that often different names are given to the same species, and, contrariwise, it is quite possible that more than one species has been confused under the same name.

There are apparently many more species of *Spondylus* in nature than admitted in literature, but their nomination is involved through the attempts at fixing our shells on to pictures of extralimital species. Hedley allowed, in the Queensland list, ten species, simply collating the names on record by various workers, thus : *S. barbatus* Reeve, *S. foliaceus* Chemnitz, *S. hystrix* Reeve, *S. multisetosus* Reeve, *S. nicobaricus* Chemnitz, *S. pacificus* Reeve, *S. tenebrosus* Reeve, *S. tenuispinosus* Sowerby, *S. victoriae* Sowerby and *S. zonalis* Lamarck.

Five had been reported by Melvill and Standen from Torres Straits: *S. barbatus* Reeve, *S. foliaceus* Chemn., *S. nicobaricus* Chemn., *S. ocellatus* Reeve and *S. pacificus* Reeve.

Then Shirley added *S. coccineus* Lam. from Moreton Bay, *S. imperialis* Chemn. from Cardwell, *S. tenellus* Reeve from Caloundra, and Hedley reported *S. anacanthus* Mawe from Palm and Lizard Isles.

Of all these names only *S. tenebrosus* Reeve had been described from Queensland. At first sight *pacificus* Reeve and *anacanthus* Mawe appear to refer to the same Australian species, while *S. foliaceus* Chemn., *S. imperialis* Chemn. and *S. victoriae* Sowerby appear to be merely mis-identifications of another species.

Spondylus ducalis Bolten, 1798. (Plate VI, fig. 2.)

1798. *Spondylus ducalis* Bolten, Mus. Bolten, pt. ii, p. 194, September, based on Chemn. VII, t. 47, figs. 476, 477 : Indian Ocean.

The commonest *Spondylus* on the Great Barrier Reef has been so determined by Hedley, and specimens from Low Isles agree generally with the figures of Chemnitz cited in Bolten. This form appears to have a wide range without showing much tangible variation, as specimens from Banga, Philippine Islands, in a worn condition agree well with worn Queensland shells. It is a heavy shell, with short spines and not much coloration inside, and, when alive, is not distinguishable from its surroundings, so covered with growth it always is. When cleared it shows half a dozen outstanding ribs, which develop a few rather distant scalloped scales, the intervals being finely lined with slender ribs, which may be smooth or bear prickles. The hinge line is heavy and marked with brown, the interior being otherwise white, with the internal edges of the valves crenulate and marked with pink and white lines, never being uniform in deep colour as far as yet seen. It is pinkish outside, with white lines, not showing broad purple bands, and the variation from young to adult has been traced as follows :

A series from Michaelmas Cay begins as an ocellate juvenile, then become almost unicolour purple outside and white inside, with a crinkled edge, the elevated crinkles whitish, the intervals purplish. The sculpture consists of radials, the major ones with small spines, which develop towards the margin into thicker spikes. These major radials number from ten to twenty, and there may be two to four minor ones between each major one. The triangular area is large and twisted, and shows a small smooth juvenile, and from this it is seen that the shell is not adherent by means of the umbo, but by the lower valve after a period of free growth. The hinge shows brown patches at each side, the teeth being white. Later these major radials tend to produce scales, and these scales even become elevated, but usually only some half-a-dozen show constant progress, while more commonly the scales all meet with disaster. On the lower valve a series of wrinklings sometimes occur, and this suggests a discrepant sculpture in the ancestry of this kind of Spondyloid shell. This is not seen in the type of *Spondylus*, whose sculpture appears to be normal, and the large triangular umbonal area with stout hinge-teeth has suggested the subgeneric name *Lanilda*, this species being type, the name used being *Spondylus ducalis*, the authority *Bolten*. Prashad, as the latest writer on the subject, states (p. 3) : " I have . . . accepted Museum Boltenianum names as valid, but the author of this work was undoubtedly P. F. Röding and not Bolten. The work may have been done by Bolten in collaboration with Röding, an accomplished conchologist. . . . In any case

the work, even in the first edition, was published after Bolten's death, and, as is clear from the preface, the literature references, etc., which alone have made the acceptance of the work possible, were the work of Röding. There is thus no justification for crediting Bolten with any part of the work, and I have, therefore, cited Röding as the author of all genera and species that have to be accepted from Museum Boltenianum." This view does not fairly represent the facts as put forward in the Preface and Introduction. The essential items are here transcribed, as the book is not available to every reader; I am quoting Dall's translation. Lichtenstein, who was asked to write the preface, stated: "At first sight, perhaps those who are both judges and friends of conchology will be disturbed at the great number of new and unheard of names, especially generic names, met in the catalogue. They must, therefore, be informed from what source arose this unique nomenclature, destitute of current authority. The celebrated Boltenius had indeed worked out a new and peculiar system of conchology, quite different from all other systems of previous writers, and this system thus carefully worked out he had brought into real scientific form, prepared and constructed according to the special rules of conchological knowledge . . ."

Then Röding explained further: "The great diversity of the collection caused the owner (*Bolten, not Röding*) to select his own system of classification, and he (Bolten, not Röding) bestowed upon his specimens, *as the list will show*, Latin and German names, but, although these were fortunately and well chosen, many of them would nevertheless remain entirely unknown to foreigners. On account of my love of natural history (*not conchology*) I accepted the labour and have added the Latin names according to the 13th edition of Gmelin's 'Linnean System', as well as many references to figures of the specimens."

Thus it must be acceded that Bolten was the author of the genera and nominator of the species, and all that Röding (*who does not claim to be a conchologist*) did was to correlate the Boltenian names with those already proposed and recorded by Gmelin in his edition of the 'Systema Naturae' and select some figure to give some idea of the species to be sold. The fact that Bolten was dead may have some bearing, but it may be pointed out that this factor has never been unfairly used hitherto. Two classical instances come at once to mind. Forskål is cited throughout his work by Prashad, but everyone knows Forskål was dead and his notebooks were printed, unfortunately, under the direction of Niebuhr. No attempt has yet been made to cite Niebuhr as the author of Forskål's names. Hermann died and his 'Observationes' were collected and published under the editorship of Hammer, yet Hermann is always quoted. A third, perhaps even better known is that of Forster's 'Descriptiones Animalium', published under the care of Lichtenstein so many years afterwards that although Forster is always given as author, after the name of the work, "(ed. Licht.)" is added to explain the lapse of time.

Many recent parallel cases could be brought forward, but there should, from the data given, be no hesitation in allowing Bolten to stand as the authority for his own names, especially as Röding disclaims them completely, and even apologizes for his own shortcomings in the matter of citing the references correctly.

Burrington Baker ('Proc. Acad. Nat. Sci. Philad.' LXXV, p. 141, 1923) concluded: "Bolten, the student and collector, may have been a consistent binomialist and an excellent systematist, but Roeding, the constructor of the sales catalog, and the only authority that might be quoted, was certainly neither."

Spondylus tenebrosus Reeve, 1856.

1856. *Spondylus tenebrosus* Reeve, Conch. Icon. IX, pl. ix, fig. 33, May : Moreton Bay, Queensland.

Specimens from Moreton Bay, agreeing with Reeve's figure and description, show this species to be the mainland representative of the reef form, *ducalis* Bolten. Shirley added *S. tenellus* Reeve (*idem, ibid.*, pl. xviii, fig. 67, June, 1856) from the same locality, but *tenellus* Reeve is in common use for the *Spondylus* found in New South Wales, Victoria, Tasmania and South Australia. Fulton has accepted this determination, and the southern shell appears to be closely related to the West Australian *S. violacescens* Lamarck ('Hist. Anim. s. Vert.' VI, pt. 1, p. 193, July, 1819 : King George's Sound, W.A.), as figured by Chenu (' Illustr. Conch.', "Spondylus", p. 5, pl. xxvii, figs. 3, 3*a*, 1844–5). On the other hand, the relationship of *tenebrosus* Reeve to *ducalis* Bolten is seen in the interior edging of the valves, which is crinkled in the same manner, but the interstices of the wrinkles are unicolour, save near the hinge, the lateral teeth and sockets are deep brown, the median white exactly as in *ducalis*. Odd specimens might be confused, while the violet edge recurs in extralimital shells from New Caledonia, New Britain, etc., which have a smoothish exterior and a banded purple and white coloration, and are obviously distinct from the Queensland *tenebrosus*. Mainland shells sent from Yeppoon, Keppel Bay, Queensland, by Mr. H. Bernhard are larger than the Michaelmas Cay specimens of *ducalis*, more lengthened, and the upper valve less convex. The sculpture is similar but more regular, not producing the longer spikes and with a shorter triangular area, less twisted. The hinge is brownish at the edges, the teeth pale, but the inner margins of the valve are less wrinkled and become almost smooth with age. A broad purple border is characteristic of these shells, and recalls the description of *S. lamarckii* given by Reeve, but the outside of Reeve's shell is smooth. Chenu's *lamarckii* was given to the squamiferous shell, the smooth one being ranked as a variety only, and he doesn't mention the colouring of the border. Mr. Bernhard has written that the very young shell has only a faint yellow edging, which gets darker and deepens into purple, the oldest shell having the darkest coloration.

"*Spondylus nicobaricus*."

Melvill and Standen included *Spondylus nicobaricus* Chemnitz from Torres Straits, although Smith had previously recorded *S. multisetosus* Reeve from the same place. Judging from Reeve's expressions of the two species the latter differs in being minutely scaly between the principal spinose ridges. Fulton also allows these as separate species, but for the former used *hystryx* Bolten, citing as synonyms *radians* Lamk., *aculeatus* Brod., *ciliatus* Sow., *nicobaricus* Sow. and *coccineus* Sow. and Reeve, not Lamarck. Then, as a variety, Fulton admitted *ocellatus* Reeve.

Many young very spinose shells showing the coloration of *ocellatus* have been met with, but apparently this is not a specific character, but of higher group value. It may be noted that Melvill and Standen also recorded *S. ocellatus* Reeve from Torres Straits, while Reeve figured many species—*ocellatus*, *plurispinosus*, *zonalis*, *virgineus*, *castus*, *spectrum* and *nicobaricus*—all showing spotted juveniles. Fulton has admitted all these save *ocellatus* as species. Lynge, on the other hand, unfamiliar with natural groups,

suggested that they were all variations of one species, including in the medley also *ducalis* Chemnitz, *fragilis* Sowerby, *tenuispinosus* Sowerby, etc., etc.!

Spondylus lindea sp. nov.

A series of specimens collected at Lindeman Island shows the following distinct features, and from these it may be possible to elucidate the problems of the spinose *Spondylus*. All appear to begin as a minute smooth shell, unspotted, then they develop spots while the radials are growing and thus parade as " *ocellatus* ". However, after this stage they assume their specific characters, and thus we have one rather longer than broad, densely radially spinose on the upper valve, which is slightly convex; the lower valve is very deep and the triangular area very large, sometimes straight, but more often twisted; the sculpture on the lower valve is peculiar, being concentric rows of lamellae, but sometimes a little scaly at sides; these lamellae become very pronounced towards the edge of the shell; the interior is white, the inner edge wrinkled, a few darker blotches appearing.

This is *multisetosus* of Hedley, but is certainly not Reeve's species.

Spondylus percea sp. nov.

One very beautiful shell collected at Lindeman Island is pure white, only the umbonal area ocellate, and is only slightly convex, broader than long. The spines are lengthened, arranged in many regular rows, and between these rows are many minor rows of prickles. The larger series of spines numbers about thirty radials, and there are two or three minor rows between each major one. The interior is all white, a touch of brown at each end of the hinge. The triangular area is median, a little twisted, but the lower valve was very thin and adherent all its length, so that it was impossible to detach it, the whole shell very shallow.

Spondylus parocellatus sp. nov.

Another series from Lindeman Island begins in a similar manner, but the radials are in regular rows and minor rows intercalate; when about half grown, however, the minor rows become obsolete and the major rows strengthen, the spines becoming elongate; the lower valve becomes strongly spinulose at the sides, being medially adherent throughout its growth; the triangular area is straight, rarely a little curved and fairly large; the hinge area is more brownish than usual and the inner margins of the valves reddish; some specimens have the white ground-colour predominating, in which case the edging is white; in others the blotching coalesces to make a reddish shell, and in such cases the inner edging is reddish, always wrinkled.

This appears to be most like Reeve's *ocellatus*.

Spondylus pernux sp. nov.

A couple of valves were collected by the late A. R. McCulloch, of this Museum, in a dredging from 10 fathoms of St. Crispin Reef, Outer Barrier, North Queensland. They attracted notice by their curious little broadly-toothed scales, like little paws, and in the

'Conchologia Iconica', on pl. xviii, fig. 64, June, 1856, is figured a little shell very similar under the name *S. nux*; it is said to be coral-red and five-ridged, though the illustration is differently coloured. Fulton has not apparently found any locality, as he makes it a synonym of another Reevean species, *S. imbutus*, also from unknown locality.

Hedley had determined it as *S. aurantiacus* Bolten, probably from Reeve's figure of *S. croceus* Lamarck, following the synonymy of Fulton, but the record had not been published.

"*Spondylus coccineus* Lamarck, 1819."

1819. *Spondylus coccineus* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 190, July 31st: No locality. In the cabinet of M. Dufresne.

Shirley recorded *Spondylus coccineus* Lamarck from Moreton Bay, and a shell is in this Museum from that locality with a reddish edge, which may be a variation of *tenebrosus*. On the other hand, there is a series of shells from Mapoon in the Gulf of Carpentaria with a constant red edging, to which the name "*coccineus*" would be applicable. However, Fulton wrote regarding "*S. coccineus* Lamk.": "The type of this species was in the 'Dufresne' Collection, which has probably been dispersed and the types lost sight of." The Dufresne Collection is now in the Royal Scottish Museum at Edinburgh, and the type should be referred to. Lynge (p. 150) even regarded *S. occllatus* Reeve as equivalent to *coccineus* Lamarck—another complication.

Spondylus pacificus fortior subsp. nov.

1856. *Spondylus pacificus* Reeve, Conch. Icon. IX, pl. i, fig. 1, January: Lord Hood's Island, Pacific Ocean.

Specimens collected at Low Isles agreed generally with Reeve's figure, but not so well with his description. Similar shells had been recorded from Palm Island and Lizard Island by Hedley ('Proc. Linn. Soc. N.S.W.' XLVIII, p. 302, 3rd October, 1923), under the name *S. anacanthus* Mawe. Previously, however, Melvill and Standen had given *S. pacificus* Reeve from Torres Straits, and obviously this related to the same style of shell. Fulton has allowed *anacanthus* Mawe and *pacificus* Reeve as distinct species, and our shells are more like Reeve's figure of the latter than his idea of the former; *pacificus* was separated on account of its "obliquely triangular compressed growth", while Mawe's species was said to be of "elevated regular gibbous growth". The Queensland shells are of the form of *pacificus* and generally depressed, but more elevated than Reeve's shell, though not of gibbous growth; topotypes of Reeve's species are also much smoother, so that the local shell is separated as above, and *anacanthus* Mawe can be eliminated from our list.

Dunker ('Zeitschr. für Mal.' 1852, p. 55) introduced *Spondylus sanguineus*, from unknown locality, and this was figured in his 'Novitates Conch.' (Moll. marin.), p. 26, pl. viii, figs. 4, 5, 1858, and compared with *nudus* seu *inermis* Chemn. It seems as rough as the Queensland form, but is much more regular in shape, being 44 mm. in length and breadth. This species appears to have been overlooked by Fulton.

This form is always very minutely sculptured and broader than high, rather thin, never growing to a large size, with the umbonal area abnormally large, the hinge teeth being comparatively small, with a roughly denticulate hinge line. This may be called *Eltopera* subgen. nov., the Australian shell *S. pacificus fortior* being named as type.

Spondylus wrightianus ella subsp. nov. (Plate VI, fig. 1.)

1872. *Spondylus wrightianus* Crosse, Journ. de Conch. XX, p. 360, October : " Nichol's Bay," Australia, *i. e.* North-West.
1873. *Spondylus wrightianus* Crosse, Journ. de Conch. XXI, p. 253, pl. ix, figs. 1, 1*a*.

Smith (' Zool. Res. Alert ', p. 114, 1884) reported *Spondylus victoriae* Sowerby (' Proc. Zool. Soc. (Lond.)' 1859, p. 428, pl. xlix, fig. 8) from " Flinders and Clairmont, Islands N.E. Australia, 11 fms., sand and mud bottom, and Port Molle, 10 fms. (*Coppinger*) ". As a variety he allowed *Spondylus wrightianus* Crosse ; the latter had been described from Nichol Bay, Australia, while the former had been localized as from " Gulf of California ". Smith stated that the latter locality was incorrect and that Sowerby's description was very insufficient. Hedley thus admitted *victoriae* to the Queensland list, and Fulton has included *victoriae* and *wrightianus* as distinct species, apparently following Smith's decision.

Dead valves have been met with at Cape Sidmouth and Mapoon, and a small valve was dredged at Station XIV, Low Isles. Two beautiful specimens were found inside a dead clam shell at Three Isles, but were unfortunately lost. Since, good specimens have been dredged in 9–12 fathoms off North-West Island, Capricorn Group, Queensland, and one is here figured. It will be seen that there is not much resemblance between this figure and that of Sowerby, and that it agrees very minutely with that of Crosse. In every specimen the long spines are straight, and none take on a frondose appearance. Shirley added " *Spondylus imperialis* Chem." from Cardwell, by which obviously the present species was intended, the authority being Chenu (' Illustr. Conchyl.' p. 6, pl. xxvi, figs. 2, 3, 1844–5), the locality, Indian Seas, of which the spines differ at sight. It is probably also *Spondylus foliaceus* Chemnitz, recorded by Melvill and Standen from Torres Straits, but not the real species of Chemnitz. The minute sculpture will separate the species easily, and the Queensland shells show only four or five major rows of elongated spines, while between these are three or four rows of minor spines ; all the spines flatly rounded, being grooved below in their early stages, but none are themselves spinose. The typical *wrightianus* was said to have six or seven major rows, and some West Australian specimens show this many. There is a median row seen which is missing in all the East Australian specimens yet examined. Crosse wrote, " interstitia elegantissime granoso-squamulata ", and in this respect the Queensland sculpture is much finer, being rows of very minute grains. Crosse's measurements read : breadth 56, with spines 115 ; length 75, with spines 95 mm. The figured specimen is about the same size, so that it will be seen how similar it is and quite unlike the Sowerbyan figure of *victoriae*.

Since the preceding was written, specimens have been dredged by Mr. Melbourne Ward at Lindeman Island, Whitsunday Group, in about 8 fathoms, and these show only four major rows of thinner longer spines on the upper valve, while the minor rows are composed of thinner finer spines correspondingly. An old shell covered with all kinds of growth has the major spines fewer, shorter, thicker, but still only in four rows ; the minor spines are also shorter, less slender and fewer. A corresponding old shell from North-West Australia has six major rows still with more long spines remaining, though similarly growth-covered. Thus, while there is a difference between the specimens from the east and west coasts of Australia, it can scarcely be regarded as specific, so that the

Queensland shells may be called *S. wrightianus ella* subsp. nov. Fulton recorded *victoriae* as the name of the Queensland species, observing, " The frondose spines distinguish this from the following species (*wrightianus*), but the Queensland species does not have frondose spines anything like the figure given by Sowerby ".

The long spining of this group of species is very characteristic, and as it is accompanied by other features, such as the smallness of the umbonal area, the similarity of the sculpture of the two valves, and the finely denticulate hinge line, with small hinge-teeth, the subgenus *Sponvola* is introduced, *S. wrightianus ella* being named as type.

Family Plicatulidae.

The little shells included in the genus *Plicatula* have commonly been ranked next to *Spondylus*, and would have been included in the family Spondylidae were it not for the peculiarity of the animal. An animal that can be associated with the animal of *Amusium* and have a shell so entirely different must be separated with family rank.

Shell small, very stout, flattened, fixed by the lower valve, sometimes by the umbo only, other times with most of the valve ; the hinge with the strongly plicate teeth that give the genus its name, the subcircular muscle scar being prominent.

Prashad (p. 115) observed : " The anatomy of *Plicatula* has been recently worked by Watson, and I follow his suggestion in placing *Plicatula* in a distinct subfamily, Plicatulinae, equal in rank to Amussiinae, Pectininae, and Spondylinae of the family Pectinidae." The ranking of these must necessarily be raised to family value, as in the Pectininae there are series as different from each other as the Amusiinae, while it is possible that the Plicatulidae have evolved from some distinct group.

Genus *Plicatula.*

1801. *Plicatula* Lamarck, Syst. Anim. s. Vert. p. 132, January.
Haplotype : *Plicatula gibbosa* Lamarck.

When Lamarck introduced this genus he cited as illustrating his species " ' List Conch.' t. 210, fig. 44 ; ' Petiv. Gaz.' t. 24, fig. 12 ; ' Chemn.', VII, t. 47, figs. 479–482 ; ' Encyclop.', t. 194, fig. 3 ; *Spondylus plicatus* L." In his later work, recognizing the mixture in the citations, he proffered a solution thus, rejecting the name *gibbosa* ; *P. ramosa* for " *Spondylus plicatus* Lin. Gmel., p. 3298. *P. gibbosa* ante. ' Chemn. Conch.' VII, t. 47, figs. 479–480 ", and *P. cristata* for " ' List Conch.' t. 210, fig. 44, ' Chemn. Conch.' VII, t. 47, fig. 481, and ' Encyclop.' pl. 194, fig. 3 ".

Linné's *S. plicatus* was described (' Mus. Lud. Ulr.' p. 511, 1764) without illustration or locality, but in the 12th edition of his ' Systema Naturae ' he added ' Rumph. Mus. ' t. 47 ; ' Gualt. Test.' t. 99 fig. 2 ; Habitat in Java ". Hanley has determined this as equivalent to the common Chinese " *imbricata* " (*i. e. sinensis* Mörch), but Lamarck's localities were American Seas, so that the type of *Plicatula* must be the American form, whether the name be *gibbosa*, *ramosa* or *cristata*. Dall made *gibbosa* Lamarck, 1801 = *ramosa* Lamarck, 1819, but the majority of the early references are given under *cristata*

Gmelin (' Syst. Nat.' VI, p. 3298, 1791) under *Spondylus plicatus* gave the following references : ' Mus. Lud. Ulr.' 511, n. 80* ; ' Adans. Seneg.' I, t. 14, fig. 2, Garin. ; ' List

Conch.' t. 210, fig. 44, et t. 1059, fig. 1 ; 'Gualt. Test.' t. 99, fig. E, et t. 104, fig. F ? ; 'Schroet. Litterat.' I, t. 1, fig. 7 ; 'Chemn. Conch.' VII, t. 47, figs. 479–482 ; (β) 'Regenf. Conch.' I, t. 9, fig. 30. Habitat in Oceano indico et americano, mari rubro, mediterraneo, (β) in Guinea."

Plicatula australis Lamarck, 1819.

1819. *Plicatula australis* Lamarck, Hist. Anim. s. Vert. VI (1), p. 185, July : "Mers de la Nouvelle Hollande, à l'île Fourneau", probably = West Australia.

Lamarck's character, "margine undato, non plicato", does not agree with that of *P. imbricata*, with which Lynge (p. 152) would associate it, though "echinata" suggests it.

Lamy ('Bull. Mus. d'Hist. Nat. Paris', 1918, no. 7, p. 513, 1919) has determined Lamarck's type as equivalent to *australis* Krauss from the Cape of Good Hope, and *multiplicata* Deshayes from Réunion, and agreeing with Sowerby's figures ('Thes. Conch.' I, p. 436, pl. xci, figs. 20–22, 1847) of Philippine Island shells. This indicates the general features of the form which is distinguished from the *imbricata* form very clearly in size, sculpture, form and colour. As Lamarck's species does not live at "Île Fourneau", it probably came from Shark's Bay, West Australia, if it be Australian.

The shell we are calling *australis* is much smaller than "*imbricata*", flatter, the shell undulated, bearing small spines rarely and white spotted with dark spots. Our imbricate shell (see *infra*) is never spotted and is definitely plicate, and generally a much larger shell.

Prashad's idea of *australis* (p. 116) reads : "The subcircular shell of *P. australis* bears on the upper somewhat convex valve a large number of raised irregularly radiating ridges. These ridges are not equally developed all along, but are interrupted here and there, more particularly near the margins, and make the shell in such areas almost spinous ; in worn shells the spines are reduced to simple knobs. The colour of the shells is dull yellow, with a large number of small black dots scattered all over the surface."

Plicatula essingtonensis Sowerby, 1873. (Plate VI, figs. 3, 4.)

1873. *Plicatula essingtonensis* Sowerby, Conch. Icon. (Reeve), XIX, pl. iii, sp. 8, October : Port Essington, North Australia.

As long ago as 1848 Sowerby monographed the species of *Plicatula* ('Thes. Conch.' I, pp. 435–437, pls. xc and xci), and admitting seven species, used Australian names for extralimital forms, no Australian material being available. Thus, under the name *P. australis* Lamarck he figured Philippine specimens, and as *P. imbricata* Menke, he gave the "Chinese variety", a specimen from Bay of Manila, Philippines, and even a shell from Honduras Bay.

P. imbricata had been described by Menke ('Moll. Nov. Holl. Spec.' p. 35, 1843) from West Australia, so Mörch ('Cat. Conch. Yoldi' II, p. 61, 1853) named the Chinese variety, figured by Sowerby, *Plicatula sinensis*.

Previously Sowerby had introduced *P. philippinarum* ('Thes. Conch.' I, p. 436, 1848) from the Philippines, giving many figures of environmental variation from that locality. Twenty-five years afterwards Sowerby re-monographed the species ('Conch.

Icon.' (Reeve), XIX, 1873), and allowing *imbricata* from " China, Philippines, Honduras Bay, etc.", introduced *P. essingtonensis* for the Australian " *imbricata* ".

Owing to the fact that *imbricata* (unknown to Sowerby) was invalid the name *essingtonensis* becomes the valid name for the North and West Australian shell. Finlay, many years later, renamed *imbricata. menkeana* (' Trans. New Zeal. Inst.' LVII, 1926, p. 527, 19th January, 1927), but Sowerby's name has precedence. Specimens from Sydney, New South Wales, have been differentiated as *P. essingtonensis elusa* Iredale (' Rec. Austr. Mus.' XVIII, p. 206, pl. xxv, figs. 5, 6, 29th June, 1931), and these are generally smaller, with fewer ribs and a weaker hinge. Low Isles specimens, from 9–12 fathoms, show variation, some towards the typical form, and others more like the southern race. Large numbers were dredged off North-West Isle, Capricorn Group, in from 10–20 fathoms by Messrs. Mel. Ward, W. Boardman, G. P. Whitley and myself, and these cover every stage from young to senile, from almost smooth to strongly-ribbed imbricate shells.

Normally the species begin as a thin smoothish shell, which, when attached to the inside of a flat, smooth shell may continue comparatively smooth ; if attached umbonally to some object allowing free growth, they produce five to seven distant angulate ribs, and they may attain full size without increasing the number of ribs ; sometimes two or three intercalating ribs may be added, or, according to their attachment, they may mimic the location they have settled upon and have many small ribs as figured.

Family Limidae.

This family appears to be well circumscribed as far as recent species are concerned and somewhat related to the Pectinidae, but unfortunately few of the species have been studied. Apparently the animal varies, while the shell differs little, so that we find very similar shells covering different animals. There are many more species in nature than have yet been recognized, and until the family is split up into groups confusion will continue. The outstanding series are very distinct and are probably less closely related than has been lately accepted, the living animals being superficially very distinct. Thus two swimming forms are found to have shells very different, so much that the features shown by the shells have been used to discriminate the swimming from the non-swimming species. These have apparently developed different swimming apparatus, which should be investigated, especially as the form with practically closed valves can swim as strongly as the one with valves most gaping. Further the presence and disuse of a byssus needs consideration, as many species may be found fixed through life, though as " *Pecten* " has been shown to be able to detach its byssus and swim and then re-attach, this group may furnish similar examples.

The division of *Lima* has presented difficulty owing to the workers who have dealt with it. Natural groups are very evident in the field, and that very brilliant malacologist, Mörch, provided the first attempt. Accepting the Kleinian pre-Linnean generic names, Mörch ('Cat. Conch. Yoldi', II, 1853) admitted *Ctenoides* Klein for *scabra* and *tenera*; *Radula* Klein for *lima* Linné; *Mantellum* Bolten for *inflata* Ch. = *fasciata* L. and *hians* Gm. and *Limatula*.

H. and A. Adams followed, accepting this interpretation, but adding *Acesta* for the giant Limas.

Many years passed until Dall's historic essays on bivalve classification appeared, when he rejected the Kleinian names, and revivified *Lima* as follows ('Trans. Wagner Free Inst. Sci. Philad.' III, pt. 4, 1898 (end), p. 765):

Genus *Lima*.

Subgenus *Lima* s. str.	Hinge edentulous; valves gaping, inaequilateral.		
Section *Lima* s.s.	Sculpture radial . . .	*L. lima*, L.	
Ctenoides Ads.	Sculpture divaricate . .	*L. scabra* Born.	
Plagiostoma Sow.	Sculpture feeble, radial .	*L. gigantea* Sow.	
Mantellum Ads.	Submargins not impressed	*L. hians*, Gm.	
Subgenus *Limatula* S. Wood.	Valves closed, equilateral	*L. subauriculata* Montg.	

These diagnoses are not very convincing, though the groups are very clearly separable when the shells themselves are examined and studied.

Comparatively recently Thiele monographed* the group in the 'Conch. Cab.' VII, Abt. 2*a*, hefts 21–22, 1918–20 ?; and referring *Lima* back to Chemnitz, 1784, a non-binomial worker, was able to use it for the *scabra* series, and then use *Radula* Klein for the *lima* group, and *Mantellum* Bolten for the *inflata* forms.

Obviously some reconsideration was necessary, and it appears that Winckworth, who has shown some aptitude for nomenclatorial problems, was asked to investigate, and, with commendable brevity, but in this case a little too succinctly, recorded ('Proc. Mal. Soc. (Lond.)', XIX, pp. 115–116, November, 1930) the names of the groups hitherto proposed with their genotypes. Reincarnating the Polian names, Winckworth then uses devious methods to get rid of the encumbrances, ignoring the futility of his designs. The rejection of *Mantellum* may be pragmatically acceptable, but the proposition of *Limaria* in its stead is impracticable.

There are five main groups recognizable at sight in Australian waters, with others to be determined. These groups can be distinguished by form, sculpture and texture associated with less noticeable but just as important characters of the hinge. The value of the presence or absence of a byssus is indefinite, but appears worthy of note, while some forms have developed hinge teeth, which may be later of use in distinguishing species and genera.

Lima: Shell of stout texture, very oblique, strong radial sculpture, more or less scale-bearing, the ribs round, interstices deep; ligament large, distinct lateral teeth.

Austrolima: Similar to above in shell features, but radials less pronounced, angulate and with shallow interstices.

* Prashad observed (p. 4): "No bibliographical information has been available in reference to this work, but the copies, which I have been able to examine, had the original wrappers, and the only doubt I have is in reference to plates; but as the names of the species illustrated are not printed on the plates, the above dates may be taken as approximately correct." These dates read: "pp. 1–24, 1918; pp. 24–48, 1919; pp. 49–66, 1920." Unfortunately these dates are not exact, so that the following correction may be given: Band VII, Abth. 2A, Heft xxi, 579te Lief. bears the date on the cover, 1918, and includes three sheets and five plates of the Family Limidae; the sheets bear dates, but these are of printing only; thus p. 1 is dated 10.vii.1918, p. 9, 12.vii 1918 and p. 17, 19.vii.1918. Therefore this Lieferung, with pp. 1–24, pls. 1–5, was issued some time after 19th July, 1918. On the back cover is "Inhalt", giving explanations of Plates I–V, so that the figures are named at the same time. The 583te Lieferung (Heft xxii) is dated 1920, and included the remainder of the family Limidae, including title-pages, etc. It included six sheets, dated on each sheet—1.ix.1919, 8.ix.1919, 12.ix.1919, 26.iv.1920, 28.iv.1920, 19.vi.1920. The back cover gives the Inhalt as usual, and the Lieferung including pp. 25–66, pls. 6–10, titlepages, etc., was not published until some time after 19th June, 1920.

Promantellum : Shell of thin texture, very oblique, weak radial sculpture, not scale-bearing, valves very widely gaping (sometimes nearly closed) : ligament very wide, hinge edentulous.

Ctenoides : Shell subequilateral. scarcely oblique, weak radial sculpture, sometimes scabrous, valves not widely gaping, compressed ; hinge line nearly straight ; lateral teeth present.

Stabilima : Shell elongated, subequilateral, very little oblique, weak radial sculpture, sometimes prickly, valves closed, obese.

Genus *Lima*.

1797. *Lima* Bruguière, Ency. Meth. Tabl., Vers. I, pl. 206.
Tautotype : *Ostrea lima* Linné.

1798. *Lima* Cuvier, Tabl. Elem. Hist. Nat. p. 421, January.
Haplotype : *L. alba* = *Ostrea lima* Linné

1798. *Mantellum* Bolten, Mus. Bolten, II, p. 160, September.
Logotype : Gray, Proc. Zool. Soc. (Lond.), 1847, p. 200, November, as synonym of *Lima* Brug. (type, *O. lima*).

1807. *Limaria* Link, Beschr. Nat. Samml. Univ. Rostock, pt. iii, p. 157, 17th May.
Tautotype : *L. vulgaris* = *Ostrea lima* Linné.

1815. *Limaria* Rafinesque, Analyse Nat. p. 147, new name for " *Lima* ". *Cf.* Iredale, Proc. Mal. Soc. (Lond.) IX, p. 262, 1911.

1815. *Glaucion* Oken, Lehrb. Nat. III, pt. 1, Register, p. vii.
Haplotype : *Ostrea lima* Linné (based on animal).

1853. *Radula* Mörch, Cat. Conch. Yoldi, pt. 2, p. 56-57, April. *Ex* Klein, non-binomial and pre-Linnean for *Lima* Brug., *Limaria* Link, *Glaucion* Oken.
Tautotype : *vulgaris* Link (Radula, Ch. 7, fig. 651).
Not *Radula* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 150, *ex* Syn. Contents Brit. Mus., ed. 42, p. 147, 1840, *n.n.*

The usage of non-Linnean authorities and non-binomial works has brought much confusion in this case, the acceptance of *Radula* Klein, *Lima* Chemnitz, and the interpellation of *Glaucus* Poli, all needing attention. Thus, Winckworth, accepting Poli's names, which to me are not of Linnean status, writes off *Glaucus* and *Glaucoderma* by making *Mytilus hirundo* Linné type. He notes that Gray, in 1847, had cited them in the synonymy of *Lima*, but does not accept that as validating them, but on the next page allows Gray's procedure in the case of *Mantellum* Bolten.

The selection of *M. hirundo* Linné as type of *Glaucus* is so evident a sophism that condemnation appears unnecessary. Yet Prashad (p. 119) has countenanced Winckworth's conclusions in their entirety, accepting *Mantellum* " Röding " as an absolute synonym of *Lima*, Cuvier, and utilizing *Limaria* Link as distinct, though the latter name was obviously an emendation only of *Lima*, and should have been definitely rejected as such. Fortunately I have been able to show, without prejudice, that *Limaria* is definitely, and legitimately, untenable.

Lima persquamifer sp. nov. (Plate VI, figs. 5*a*.)

Shell large, equivalve, very inequilateral, very oblique, very little gaping at sides, ears very small and unequal, valves somewhat compressed, radials strong and covered with large erect close scalloping ; coloration greenish white. The posterior side is long

and nearly straight, posterior ear very short; anterior side very short, the ear a little larger than the posterior one, the ventral margin obliquely curved and slightly denticulate through the rib-endings, the inner surface showing the ribs clearly. These ribs are elevated and rounded, numbering eighteen to twenty, each rib bearing a continuous series of close erect scalloped spines, which become longer towards the ventral margin. The posterior area shows a slightly sinuous edge and has three or four radials crossed by strong concentric lirae, which nodulate them, but do not continue on the main area, the deep interstices of the ribs there being practically smooth. The hinge area is broadly triangular, the hinge line short, the ligamental pit large and triangular, and at each end of the hinge line two very small teeth can be distinguished. Figured from a Low Isles shell from Station XVII measuring 40 mm. in height and 29·5 mm. in breadth, 16 mm. in depth.

Ostrea lima was introduced by Linné thus: "O. testa gibba radiis 22 imbricatis squamis, altero margine rotundato, auriculis obliteratis. M.L.U. Argenv. conch. t. 27 f. E. Habitat in O. meridionali. Testa alba oblonga aequivalis. Auriculae obsoletae." The descriptions of the shells contained in the M(useum) L(udovicae) U(lricae) had not been published at this date, appearing only in 1764, so that this reference cannot be utilized in the exact determination of Linné's species.

Then Argenville's figure is of a gibbous scaly *Lima*, which agrees well enough with the short description above cited. Bucquoy, Dautzenberg and Dollfus in 'Les Mollusques Marins du Roussillon', one of the best systematic accounts of molluscs ever written, used (Vol. II, p. 51, November, 1887) Linné's specific name, *lima*, observing: "Il est évident que Linné a confondu sous le nom d'*Ostrea lima* deux espèces fort voisines qui vivent, l'une dans la Méditerranée, l'autre dans l'océan Indien et la mer Rouge. L'espèce exotique a été distinguée par Deshayes sous le nom de *Lima bullifera*. Dans ces circonstances il nous a paru équitable de conserver à la coquille méditerranéenne le nom linneen, puisque le nom de *squamosa* Lamarck s'applique aussi à la fois aux deux espèces." Then they give the number of scaly ribs as twenty-three, which is near enough to the Linnean number of twenty-two to be acceptable.

To continue, *Lima squamosa* Lamarck was brought in merely as a new specific name to avoid tautonymy, and the first reference is the same as that of Linné, viz. Argenv. t. 24, fig. E. Therefore unquestionably Lamarck's name must be ranked as an absolute synonym of Linné's. A little previously Cuvier had provided *Lima alba* under the same circumstances. This settles Linné's name, *Ostrea lima*, on the Mediterranean shell, with *Lima alba* Cuvier and *Lima squamosa* Lamarck as pure synonyms. *Limaria vulgaris* Link must also be added without question.

A world-wide range has been given to this *Lima lima* Linné, the Mediterranean shell, such very different species as *Lima paucicostata* Sowerby, *L. zealandica* Sowerby and *L. bullifera* Deshayes being gathered into the medley. Even the forms resembling *Lima multicostata* Sowerby were also added as varieties! Yet as long ago as 1843 Sowerby had separated the species according to the number of ribs, thus: *Lima squamosa*, with twenty to twenty-four ribs, from the Red Sea and the Mediterranean, the variety from the Red Sea being more oblique, with sharper, more numerous scales; *L. multicostata*, with thirty-five ribs, from the Mediterranean?; and *L. paucicostata*, with twelve or thirteen ribs, from unknown locality. Observing that the West Australian shells had few ribs, Hedley selected *paucicostata*, but using the British Museum nomination I reverted to

lima, though I pointed out that *multicostata* was a very distinct species, living alongside and not a variety, as had been claimed by some authorities. Odhner used *L. squamosa* for reasons unknown, while Von Martens had selected *L. sowerbyi* Deshayes—a name given to the Red Sea variety indicated by Sowerby. Eastern shells are not yet separable from those of West Australian, and are therefore described, as it will be seen none of the names above cited are applicable.

Genus *Austrolima.*

1929. *Austrolima* Iredale, Rec. Austr. Mus. XVII, p. 165, 4th September.
Orthotype : *Lima nimbifer* Iredale.

The note at the introduction of this name reads : " Shell small, like *Lima*, restricted, but non-swimming, attached throughout life by a byssus ; animal small." Comparing the genotype with *Lima* (*persquamifer*) the hinge line is seen to be narrower, the ligamental area longer and more triangular, the ligament long and narrowly triangular instead of being short and broadly triangular. The longer hinge line of *persquamifer* is also rugose, whereas that of this species is quite smooth, the teeth in the latter being comparatively stronger.

Austrolima tropicalis sp. nov. (Plate VI, figs. 6, 6*a*.)

Shell small, equivalve, very inequilateral, anterior side short, posterior long and straight ; ears small and unequal ; coloration white ; sculpture radial ribs finely and irregularly prickly. The ribs number about twenty-five, a little angulately elevated, bearing rather distant little scallops, missing on the juvenile stages and crowded anteriorly ; interstices narrow, and showing a faint concentric striation. The anterior ear is more strongly prickly, while the smaller posterior ear has no prickles, but the posterior area is strongly waved with impressed striae. The ventral margin is denticulate by the ribs, which are seen through the inner surface. The hinge line is very short, the hinge area long and triangular, enclosing a deep ligamental pit ; a rather notable tooth can be seen at each extremity of the hinge-line. Length 18 mm., breadth 14 mm., depth of both valves 9 mm. Living among branching coral, fixed by a small byssus. A Low Isles specimen is described and figured, but the species ranges along the reef, many shells being secured at North-West Island, Capricorn Group, S. Queensland.

Easily separated from the southern " *multicostata* ", *i. e. nimbifer* ,by the fewer number of ribs.

Genus *Promantellum* nov.

Type : *P. parafragile* sp. nov.

This genus is provided for the oblique, thin-shelled, gaping, free-swimming Limoid molluscs, the Australian species above-named being selected as type. It is a common species under dead coral blocks on the reef, swimming about with a brilliant red animal as soon as the block is overturned. The shell is very oblique and gapes widely practically all round, only touching at the posterior side for less than half its length. The hinge line is oblique, the hinge area very narrow, and the ligament short and broad. Posteriorly no teeth are present, but on the posterior side of the ligament is a deep socket, probably the base of a swimming-muscle. The shell is very thin and flattened.

Winckworth has rejected *Mantellum* Bolten for this group on account of the type designation of Gray in 1847. This is a dubious interpretation of Gray's action, and may be reviewed. However, in selecting *Limaria* Winckworth is undoubtedly wrong, although his action has been accepted by Prashad without consideration. Thus Winckworth wrote: "*Limaria* Link 1807, p. 157, includes the species *vulgaris* based on Chemnitz, vol. 7, fig. 651, *asperula* on fig. 652, *mitis* on fig. 653, and *inflata* on fig. 649a = *inflata* Gmelin. I here choose *inflata* as type, thus making the name available for *Mantellum* of Mörch, and of H. and A. Adams, not of Bolten."

The type of *Limaria* must be *vulgaris*, by tautonomy, and therefore *Limaria* is an absolute synonym of *Lima*, as originally intended by Link, being merely an emendation of that name. However, Winkworth's selection is doubly invalid, as *inflata* Link is *not inflata* Gmelin, the former being based on Chemnitz's fig. 649*a*, the latter on Born, t. 6, figs. 7, 8, and Chemnitz, fig. 649*b*, a different shell from 649*a*.

Promantellum parafragile sp. nov. (Plate VI, figs. 10, 10*a*.)

Shell very oblique, thin, equivalve, very inequilateral, widely gaping; ears small, unequal, coloration dirty white, sculpture of low sharp radials, rather distant.

The hinge-line is oblique, the anterior ear small and triangular, the posterior smaller and merging into the posterior area, which is elongate, a little depressed and faintly radially ribbed; the anterior ear is succeeded by a narrow linear area, the edge of which is rather rolled back sinuously, connecting the ear to the ventral margin, which is finely denticulate by the ribs. The ventral margin only touches posteriorly, succeeding the posterior area. The sculpture consists of about thirty very fine radials, with wide interstices with no concentric sculpture save a few distant growth stages.

The specimen figured from Low Isles measures 22 mm. in height, 15 mm. in breadth and 8 mm. in depth.

This is probably the shell recorded by Hedley as *inflata* Lamarck, but there is an extraordinary confusion about the name *inflata*. Lamarck ('Hist. Anim. s. Vert.' VI, pt. 1, p. 156, July, 1819) described *Lima inflata*, citing as illustrations 'List Conch.' t. 177, fig. 14, 'Gualt. Test.' tab. 88, fig. FF, 'Chemn. Conch.' VII, t. 68, fig. 649 litt. a, and 'Encyclop.' pl. ccvi, fig. 5. Years before, however, Gmelin had given a species of *Lima* as *Ostrea inflata* ('Syst. Nat.' VI, p. 3321, 1791) based upon "'Born. Mus.' t. 6, figs. 7, 8, and 'Chemn. Conch.' VII, t. 68, fig. 649*b*." It is seen at once that Lamarck's species is different from that of Gmelin, but the two authorities have been confused. The two figures given by Born and cited by Gmelin for his species refer to two distinct shells, the fig. 7 being of "*fasciata*", the fig. 8 the basis of *bullata* Born. As Chemnitz's fig. 649*b* is also of "*bullata* Born", the specific name *inflata* Gmelin may be relegated to the synonymy of Born's *bullata* or referred to *fasciata*, but there is a prior *fasciata* Linné, which is discussed later. In any case Lamarck's *inflata* can have only a synonymic interest, and appears to be Gmelin's *fasciata*, with the addition of Chemnitz's fig. 649*a*, but it is certainly not the *inflata* of Gmelin. Chemnitz's fig. 649*a* (p. 346) was called "*Pecten inflatus utrinque hians*", from the coast of Guinea and West Indies, and Link had utilized this as the basis of his *Limaria inflata* in 1807, but this is still not available.

Promantellum stertum sp. nov. (Plate VI, figs. 8, 8*a*.)

Lima cumingii Sowerby (' Thes. Conch.' I, p. 87, pl. xxii, figs. 24, 25, 1843), described from the Island of Luzon, Philippine Islands, recalls the present species in size and may be related.

The Australian shell is small, thin, very oblique, not gaping, but otherwise resembling *parafragile* in shape but a little more attenuate. The hinge differs in being narrower, but showing a broader ligament, which continues right across the hinge area, and below the ends are swimming sockets, suggesting it swims strongly although it does not gape. The ears are small and a little unequal, the anterior a little triangular, with very little sinuosity, the posterior merging straightly into the posterior area, which is not ribbed. Otherwise the fine distant radials cross the shell to the anterior ear, numbering about twenty, the interstices being very broad and ventrally showing a fine concentric lacing, the margin denticulate with the terminations of the ribs.

The specimen figured from Low Isles measures 11·5 mm. in height, 7 mm. in breadth and 3·5 mm. in depth.

Promantellum vigens sp. nov. (Plate VI, figs. 7, 7*a*.)

Shell large, oblique, thin, but of thicker texture than the genotype, convex, not much gaping; coloration white, radially ribbed. The hinge line is short and oblique, the short broad ligament occupying more than half the width, with a continuation on each side; underneath the anterior end is a swimming socket, but none posteriorly. The small anterior ear is smooth and the radial ribbing otherwise extends across to the posterior edge, the posterior area being similarly rayed. These radials are angulate and stronger than in the preceding congeners, and the broad interstices are divided by a smaller intercalating rib, there being also a faint concentric lining present. The main ribs number about thirty and there are as many subsidiary intercalating ribs in an adult shell, but more appear in the senile stage.

The figured specimen from Low Isles measures 33 mm. in height, 23 mm. in breadth and 16 mm. in depth.

This species was listed by Hedley as *Lima angulata* Sowerby (' Thes. Conch.' I, p. 86, pl. xxii, figs. 39, 40, 1843)—a Panama species—but fortunately Sowerby's name is invalid, being preoccupied by Muenster. Two other names have been cited in this connection, *Lima basilanica* and *Lima orientalis*, both of A. Adams and Reeve (' Zool. Voy. Samarang', p. 75, pl. xxi, figs. 6, 7, August), from the Philippine Islands. Prashad (p. 125) has discussed the identity of *orientalis* and *angulata*, and figured specimens of each, showing the distinctions between the two species. He did not note the invalidity of the Panama name, although it had been recorded years before, nor did he mention *basilanica* at all. However, it does not matter, as the species are quite different, and neither is identical with the Australian shell here named.

Lamy (' Journ. de Conch.' LXXIV, p. 180, 29th November, 1930) had earlier confused these species in a different manner, proposing *Lima* (*Mantellum*) *orbignyi* for *Lima angulata* Sowerby, though adding the earlier *Lima braziliana* as a synonym. Then he quoted "Forme *basilanica* Adams et Reeve", giving as a synonym *orientalis*, though obviously these differed in form, the latter being broader and more gaping than the former.

Promantellum noverca sp. nov. (Plate VI, figs. 9, 9*a*.)

Shell small, oblique, like the miniature of *P. vigens* Iredale, but more convex and with different sculpture. The posterior area is not ribbed and the radials fade away on the anterior portion, so that in some specimens the shell is smooth anteriorly. The radials number about twenty, fine and sharp with very wide interspaces and no intercalating ribs, but a faint concentric threading may be sometimes distinguished.

The specimen figured, from Low Isles, measures 10 mm. in height, 8 mm. in breadth and 7 mm. in depth.

Promantellum delicatule sp. nov. (Plate VI, figs. 13, 13*a*.)

A gaping species, differing from *P. parafragile* Iredale in form and sculpture, the latter consisting of many crowded, very fine radials.

The shell is of medium size, very thin, very oblique, with the hinge line short, the ligament short and very broad and with a continuation on each side, a swimming socket anteriorly. At this side the ear is very small and triangular, succeeded by a strong sinuous anterior edge, which is notably thickened, while the anterior portion of the shell is flattened, the posterior is more convex, the posterior area smooth. The radials extend across the shell, but leave a small anterior area unsculptured; the very fine ribs are numerous, numbering about fifty, large and small, but do not denticulate the ventral margin.

The specimen figured, from Low Isles, measures 18 mm. in height, 11·5 mm. in breadth and 6 mm. in depth.

Ostrea fasciata Linné, 1758.

1758. *Ostrea fasciata* Linné, Syst. Nat. 10th ed., p. 699, January, for Gualt. Test., t. 74, fig. E : O. australiore.

Hedley used this name for a species of *Lima* equivalent to *linguatula* Lamarck, but Hanley (' Ipsa Linn. Conch.' p. 112, 1855) had fully discussed this name, and correctly advised its absolute rejection as indeterminable. To convey the reason shortly it may be stated that the description disagrees altogether with the figure cited, which is of a "*Pecten*", not a Limoid shell at all. Later, in the ' Mus. Lud. Ulrich." the citation "f. E" is altered to "f. EE", which is of a Limoid shell of the "*scabra*" type, but the description speaks of twenty radials while the figure shows none. Consequently, as both figures fail to support any determination of the name, the description giving no generic indication even, there can be no accurate usage and the name must be rejected in this connection.

Lamarck (' Hist. Anim. s. Vert.' VI, pt. 1, p. 157, July) had introduced *Lima linguatula*, from "Mers de la terre de Diémen, M. de la Billardière". However, he cited "*Ostrea hians* Gmelin" as equivalent, and therefore Lamy has determined Lamarck's species as a synonym of Gmelin's species. Otherwise Martens, Lynge and Thiele have synonymized Lamarck's species with *fragilis* Gmelin, but their valuation of *fragilis* is very vague. As a matter of fact, Gmelin's species *Ostrea fragilis* (' Syst. Nat.' VI, p. 3332, 1791) was based on a shell, figured by Chemnitz (' Conch. Cab.' VII, p. 349, t. 68. fig. 650), from the Nicobar Islands, and there is no shell in Australia corresponding to

Chemnitz's figure. Melvill and Standen added *Lima arcuata* Sowerby to the Queensland list, but Sowerby's species was described ('Thes. Conch.' I, p. 86, pl. xxii, figs. 41, 42, 1843) from Lord Hood's Island. However, Sowerby's name was invalid, as Geinertz ('Mem. Soc. Geol. Fr.' II, p. 16, 1837) had used it before Sowerby selected it. The species Melvill and Standen intended was probably of the *fragilis* style.

Genus *Ctenoides*.

1853. *Ctenoides* Mörch, Cat. Conch. Yoldi, pt. 2, p. 56, April. *Ex* Klein, non-binomial: Logotype: Kobelt, Illustr. Conch., p 374, 1881, *Ostrea*.

These peculiarly-shaped members of the family certainly deserve generic separation, their shape, compression and hinge definitely distinguishing them. As above noted, Dall gave them sectional rank under *Lima*, characterized as "hinge edentulous; valves gaping, inequilateral", the sectional features being "sculpture divaricate, submargins impressed". The hinge shows features that remove it from the group "edentulous", while the valves are not gaping as some species of "*Mantellum*", but closed save for the byssal gape; the valves are almost equilateral in the juvenile, while the sculpture scarcely deserves the term "divaricate"; the submargins sometimes show a little shelving, and this may be of value, but it is often obscure through growth stress.

Ctenoides corallicola sp. nov. (Plate VI, figs. 15, 15*a*.)

This appears to represent "*tenera*" of authorities, and is here a non-swimming, non-scabrous shell. It lives affixed through rather a large byssal gape, which is toothed at each extremity. The hinge line is short, the ligament very long and comparatively broad, sometimes continuing at each side. The sculpture consists of fine radials, which become worn through abrasion, but when seen are fine non-scabrous, with the interstices narrow but striate.

The shell is somewhat distorted through its environment, but the general effect is somewhat pear-shape, the hinge line short, the hinge area broadly triangular.

The figured specimen, from Low Isles, measures 24 mm. in height, 18·5 mm. in breadth and 11 mm. in depth.

Ctenoides ales Finlay, 1927.

Hedley described *Lima alata* ('Rec. Austr. Mus.' III, p. 84, fig. in text. 13th June, 1898), from Santa Cruz, and later recognized it from Queensland. Finlay, noting that the name was preoccupied, provided a substitute, *Lima ales* ('Trans. New Zeal. Inst.' LVII, 1926, p. 527, 19th January, 1927). Hedley had previously regarded his species as identical with *Lima dunkeri* Smith ('Zool. Res. "Challenger", XVI, p. 291, 1885), but apparently Thiele disagreed, as he allowed both as valid in his monograph. The type of *alata*, as very well described and figured, is a very large specimen of the "*tenera*", not "*scabra*" series, and its shape is distinctive.

Lamy has pointed out that *Lima dunkeri* Smith is invalid, through the prior *Lima dunkeri* Hagenow ('Jahrb. f. Min.' 1842, p. 556), and has therefore renamed Dunker's *Lima japonica*, *Lima* (*Ctenoides*) *lischkei* ('Journ. de Conch.' LXXIV, p. 196, 29th November, 1930). Prashad (p. 123) admits *Lima lischkei*, and figures specimens so determined (pl. iii, figs. 25–28), giving as range "Japan and the Philippines in the Pacific, and Mauritius in the Indian Ocean". He does not even mention Hedley's *alata*, but

the Queensland shells differ in proportions from Prashad's figure, so that the Japanese name may be allowed until series are contrasted and Finlay's name discussed, as it has priority over Lamy's.

Ctenoides ferescabra sp. nov. (Plate VI, figs. 11, 11*a*.)

This is our scabrous shell, and it appears to be a free-swimming species.

Shell rather thin, a little oblique, equivalve, subequilateral, compressed, ears short and unequal, coloration brownish, sculpture fine radials ornamented with distant prickles. Hinge line short, ligament short and triangular; under the anterior extremity is a protuberance, and under the posterior a small diagonal tooth. The anterior margin is thickened and reflected, leaving a gape, but otherwise the margins touch.

The specimen figured, from Low Isles, measures 34 mm. in height, 23 mm. in breadth and 14 mm. in depth.

Lamy ('Bull. Mus. Nat. d'Hist. Nat. Paris', XXV, p. 633, 1919) has recorded that *Lima annulata* Lamarck is the Eastern shell, known as *scabra* Born, which is West Indian. Lamy synonymized *brunnea* Cooke from the Red Sea, but Cooke's species probably belongs to a different group, as he wrote " differs widely from *scabra* ", and Cooke was a great lumper. Prashad (p. 122) has used *annulata* Lamarck for the East Indian shell, and regards the Australian records of *tenera* as being based on this species.

Genus *Stabilima* nov.

Type : *S. tadena* sp. nov.

Shell small to medium, equivalve, subequilateral, hinge transverse, not oblique, ligament large, broadly triangular and extending each side of chondrophore, which obtrudes as a ledge, subcircular and succeeded by a depression on each side below the hinge line proper; ears small, pointed, subequal; a narrow linear gape at each side below the ears, the edges thickened and flattened.

Stabilima tadena sp. nov. (Plate VI, figs. 12, 12*a*.)

Shell of medium size for this genus, equivalve, slightly inequilateral, elongately oval, swollen, coloration white.

The sculpture consists of delicate radials, angulate, distant on the median sector, but crowded laterally; those on the sides are closely prickly nodulose, the median ones distantly bluntly spinose. The median series number twenty to twenty-five, with about ten on each side, the whole overridden by fine concentric threads, which become obsolete towards the margin. The hinge line is short, the ligamental triangular groove short and wide; the inner margins are smooth, the valves closing tightly with no gape whatever.

The specimen figured was dredged at Low Isles, and measures 27 mm. in height, 15 mm. in breadth and 8 mm. in depth of single valve.

In the Queensland list Hedley included *Lima bullata* Born ('Mus Caes. Vindob.' p. 110, pl. vi, fig. 8, 1780; Index, p. 95, " 1778 " = 1780), but that was West Indian. Lamy has argued that Born's species is East Indian, not West Indian, but still our shell does not agree with Born's figure, as it is more lengthened, its concentric sculpture and its prickly anterior ribbing differing.

Stabilima tensa sp. nov. (Plate VI, figs. 14, 14*a*.)

Shell very small, equivalve, equilateral, oval, swollen, white. This is more regular in shape than the preceding and differs in sculpture. The ribs are flattened, close and extend evenly on to the sides: there is only a very slight indication of scales towards the margin; the ribs number about fifty, the interstices narrow and shallow and only growth-lines being apparent.

The specimen figured is from Eagle Island, North Queensland, and measures 3·5 mm. in height, 2 mm. in breadth, and 1·25 mm. in depth. of single valve.

[Suborder DIMYIFORMES.

This suborder is mentioned to complete the series of suborders of the Pseudolamellibranchia, but the forms need investigation. The fossils, upon which *Dimya* was based, differ, and somewhat similar fossils have been found in Southern Australia. Living specimens have been trawled on the Continental Shelf of Eastern Australia, and these are furnished with a powerful resilium, and along the internal edges show nodulation. The inside is semi-pearly, and the shell is commonly almost free, being only attached by the umbones.

Jackson (p. 390) wrote: " *Dimya* is considered as a side issue from *Pecten*, possessing many archaic and modified features, which render it a highly retrogressive or degradational form ", and concludes it is " ostreaform " because it is attached.

There can be no hesitation in rejecting entirely Jackson's conclusions, as the whole facies denies such, and whatever may be its nearest ally it certainly is not *Pecten*.]

Suborder OSTREIFORMES.

Oysters certainly stand alone, probably with higher rank than here given, as they can never be confused with any other bivalve. It has been the custom of workers to assume that these are variable creatures, and so they are, but they are very easily recognizable when studied.

Although, to some degree, reacting to environmental stresses quickly, the general features are constant, and the species (in Australia) can generally be easily determined, whether they show geographical, ecological, individual or even abnormal differentiation. It may be noted that the species, as a whole, must be criticized, and when once the manner or mode of living is known there is very little trouble. The animals of the different species, which are not used commercially, would repay close investigation, especially in view of the known distinctions due to age and growth.

Family Ostreidae.

Though beloved by gourmets from the earliest times, Oysters have never been a delight to systematic conchologists. While large books have been written about their care for the table, and important theses regarding their breeding habits and eccentricities, their taxonomic study has been much neglected. It is, indeed noteworthy that nearly all the useful taxonomic work has been performed by palaeontologists, *e. g.* Dall, Sacco, Ihering, on dead fossil specimens.

In order to name the Low Isles specimens it was absolutely necessary to study the whole Oyster fauna of Australia, and secondarily that of the Indo-Pacific area. In a difficult group such as this it has been customary that local workers should bow to the superior knowledge of over-sea authorities, with dire results. No one without good local knowledge has any hope of solving the problems in this group, as each locality has produced its own puzzling question. The present review is based on examination of the animals in nature with regard to the variation seen in collections, and it was definitely found that Oysters, as should have been concluded, were quite constant in their features when their environmental conditions were known. Probably many specimens could be collected which would be difficult to locate without exact information whence they were procured, but that does not alter the fact that Oysters are comparatively easy to separate into groups, species, subspecies and ecological variants.

On account of their edible quality they would obviously be collected by the first voyagers to touch Australia, and probably the Dutch commonly ate them on the north-west coast before Captain Cook visited the East Coast. They are mentioned in Captain Cook's ' Journal ', while in the Portland Catalogue three lots were listed. The early French visitors apparently took home a number of specimens, and these were named by Lamarck. Unfortunately the localities became confused, through death and disaster, and moreover Lamarck's sight was then failing, so that much trouble has since ensued through these names. None of the shells, however, came from Queensland waters, so that these do not really concern us, though some of the names have been recorded in our literature. Another point to be remarked upon is the fact that later monographers, such as Sowerby, were not much concerned with details, and named Oysters, giving " Australia " as their habitat. As usually aberrant examples attracted their attention, these species are almost indeterminate.

The Oysters of Queensland are more favoured than most, as they were studied from an economic viewpoint by Saville-Kent, who prepared two lengthy reports. In these he dealt with the systematic status of all the species dealt with, and his conclusions are herewith almost entirely confirmed. The first report was entitled ' Oysters and Oyster Fisheries of Queensland ', and was issued as a Government Report in 1891. It is the usual folio size, and is accompanied by nine plates, showing most of the species and forms, the illustrations being excellent lithographs. Two years later Saville-Kent published his wonderful book on the " Great Barrier Reef of Australia ', and therein included the gist of the above-mentioned report, again providing excellent illustrations, and these become the basis of Queensland Oyster study. Apparently Hedley did not accept Saville-Kent's views, as in his Queensland list he only admitted *cerata* Sowerby, *cristagalli* Linné, *cucullata* Born, *imbricata* Lamarck, *nigromarginata* Sowerby and *tuberculata* Lamarck. Consequently Shirley thought this was due to an oversight by Hedley, so recorded as additional *circumsuta*, *glomerata* and *mordax*, with a var. *cornucopioides*, these being the names used by Saville-Kent, save that, as usual, the last-mentioned is a Shirleyan mutilation of *cornucopiaeformis*—a name introduced by Saville-Kent.

All the discrepancies will be reconciled in the following account, but before entering into the description of the species, the higher grouping must be considered. It has been known for very many years that distinct genera were represented among Oysters, but it was only quite recently that the most amusing interlude into Oyster systematics appeared. Thus, in a serious periodical like ' Nature ', Orton proposed a very extraordinary

renomination of the Oysters of the world. He separated two " genera ", which he named and defined as follows :

> " *Monoeciostrea.*—The shell is subcircular ; the egg is large ; the adult larviparous ; the individual is hermaphrodite ; spawning occurs at medium temperatures, round about 15° C. ; and the species flourish in temperate regions.
>
> " *Dioeciostrea.*—The shell is elongated in an antero-dorsal and postero-ventral direction ; the egg is small ; the adult non-viviparous ; the individual of one sex only ; spawning occurs at moderately high temperatures (round about 20° C.) ; and the species flourish in subtropical or tropical regions."

As if this absurd division was not sufficiently ridiculous, Orton suggests the following series of new names :

" *Ostrea edulis*	to be renamed	*Monoeciostrea europa.*
Ostrea lurida	,, ,,	*Monoeciostrea vancouverensis.*
Ostrea angasi	,, ,,	*Monoeciostrea sud-australis.*
Ostrea virginica	,, ,,	*Dioeciostrea americana.*
Ostrea angulata	,, ,,	*Dioeciostrea hispaniola.*
Ostrea cucullata	,, ,,	*Dioeciostrea subtropica.*"

Orton's own humorous comment reads : " A glance at the suggested new names is sufficient to show their superiority in descriptiveness." It seems to be a perverted sense of humour that suggests " *hispaniola* " as " descriptive of the ' Portuguese' Oyster ".

Without labouring the matter it can be pointed that Dall, thirty years before (' Trans. Wagner Free Inst. Sci. III, pt. 4, p. 671, April, 1898) had separated the two groups, mentioning the same facts, but correctly using names already in use, *Ostrea*, with type, *O. edulis*, being used for the monoecious group, and *Crassostrea* Sacco, typified by *O. virginica* Gmelin, for the dioecious series represented in Europe by *O. angulata* Lam.

Even earlier Saville-Kent published " Notes on the Embryology of Australian Rock Oyster " (' Proc. Roy. Soc. Queensland ', VII, 1889–90, pp. 33–40, plate, 1891), wherein he recorded that there were the two breeding states in Oysters here, reporting " *angasi* " as being monoecious, and " *glomerata* " as dioecious.

On conchological grounds alone Sacco (' I. Moll. ter. terz. Piemonte e Lig.' XXIII, June, 1897) had subdivided the Oysters in this manner :

" p. 3.	Genus *Ostrea* L.	Type *O. edulis L.*"
" p. 12.	Subg. *Cymbulostrea* Sacco	Type *O. cymbula* Lam."
	Cubitostrea Sacco	Type *O. cubitus* Desh."
" p. 14.	*Gigantostrea* Sacco	Type *O. gigantica* Sol."
" p. 15.	*Crassostrea* Sacco	Type *O. virginiana* Gmel."
" p. 16.	*Ostreola* Monts, 1884	Type *O. stentina* Payr."
" p. 18.	*Alectryonia* Fischer, 1807	Type *O. cristagalli* L."
" p. 19.	*Alectryonella* Sacco	Type *O. plicatula* Gm."
" p. 21.	Genus *Gryphaea* Lam., 1801	Type *O. angulata* Lam."
	Subg. *Pycnodonta* Fischer, 1807	Type *O. vesicularis* Lam."

As noted above, Dall used Sacco's name *Crassostrea*, but regarded *Gigantostrea* as equivalent. As the latter had anteriority it should have been preferred as Dall himself

later decided. He regarded *Cubitostrea* as synonymous with *Cymbulostrea*, which he admitted as an Eocene group. *Ostreola* was also allowed by Dall, but he preferred *Lopha* Bolten, of which he selected *O. cristagalli* Linné as type, to *Alectryonia*, but thereto added *Dendostrea* Swainson. This last-named was proposed for the small Oysters known as *O. folium* Linné, whose relationship with the large *O. cristagalli* Linné seems very distant.

A few years later Ihering, working on South American fossils, introduced *Eostrea* ('Ann. Mus. Nac. Buenos Aires' (III), VII, p. 42, 1901) for species characterized by the crenate inner margins near the hinge. Suter used this feature to separate Neozelanic fossil Oysters, but later, realizing that *Eostrea* was equivalent to *Ostrea*, introduced *Anodontostrea* ('Palaeont. Bull.' No. 5, N.Z. Geological Survey, 1917) for a series including *O. angasi* Sow., which Finlay later designated as type.

It will be seen that there is a multiplicity of names to select from, without Orton's novelties, and these are here arranged systematically for the use of biologists as well as systematists.

The Australian Oysters can be separated into groups thus :

Small to large Oysters, subcircular, sometimes adherent, sometimes free, lower valve generally comparatively shallow, coloration whitish, greenish, sometimes reddish, but very rarely bluish . . . . *Ostrea.*
Large Oysters, edges strongly crenulate, adherent, lower valve comparatively deep, coloration blue or green, but never white . . . . *Lopha.*
Small Oysters, adherent, edges finely crenulate, lower valve deep, coloration bluish . . . . *Saxostrea.*
Very small Oysters adherent by means of projections from lower valve, elongate, lower valve very shallow, coloration bluish or white . . *Dendostraea.*

While these definitions appear insufficient, the facies of the groups is distinctive, and the breeding habits are not well known; thus, while *Ostrea* is monoecious, and *Saxostrea* dioecious, the habits of the others may differ, and not be in accordance with shell superficies. As though species of *Ostrea*, *e. g. angasi*, are free when adult, sometimes they are found adherent, and it is possible that these latter may prove to have different habits.

Genus *Ostrea*.

1758. *Ostrea* Linné, Syst. Nat. 10th ed., p. 696, 1st January.
Tautotype : *Ostrea edulis* Linné.
1907. *Eostrea* Ihering, Anales Mus. Nac. Buenos Aires, VII, ser. iii, p. 42.
Logotype : *Ostrea puelchana* Orbigny.
1917. *Anodontostrea* Suter, Palaeont. Bull. No. 5, N.Z. Geol. Survey, p. 86.
Logotype (Finlay, Trans. New Zeal. Inst. LIX, 1928, p. 264) : *Ostrea angasi* Sowerby.
1928. *Monoeciostrea* Orton, Nature, CXXI, p. 321, 3rd March.
Logotype : *Ostrea edulis* Linné.

Although the species are generally subcircular, sometimes they are elongated ; all may be monoecious, but few have yet been studied ; the crenulations on the inner margins of the edges of the valves are variable ; generally free when adult, sometimes they are completely adherent ; valves shallow, but rarely comparatively deep ; coloration varied, white, green to brownish-red but not blue. Although the typical Oyster is well known as a practically non-adherent form, some adherent species are here included until the animals can be critically compared.

Ostrea nomades sp. nov. (Plate VII, figs. 1, 1*a*, 1*b*.)

1891. *Ostrea crenulifera* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 3, pl. ii, figs. 5, 7, *ante* November: Moreton Bay, Queensland.
Not *O. crenulifera* Sowerby, Conch. Icon. (Reeve), XVIII, pl. xxvii, sp. 67, September, 1871: Red Sea.

Shell small, adherent, edges wrinkled, coloration greenish. The upper valve is wrinkled with broad radial folds, about a dozen being notable, minor folds crenulating the edge, though superficially obsolete. Greenish white outside, white inside with a greenish tinge, the muscle scars pale green. The hinge is broad, the hinge plate very short. Lower valve attached almost its whole length, an uprising edge showing similar sculpture and ribbing to the upper valve. Saville-Kent's remarks read: "A small species of Oyster, which is tolerably abundant in various parts of Moreton Bay, and which has in some instances encroached upon and taken possession of banks formerly occupied by the ordinary commercial species is the *Ostrea crenulifera* of Sowerby. This species is usually less than one-half of the size of the commercial oyster, and, while somewhat resembling it in general shape, may be distinguished from that form by the more numerous, acuminately pointed denticulations of the peripheral border, which are continuous as in *O. cristigalli*, with raised ridges of the external surface of the shell, and radiate from the hinge or umbone to the periphery. Like *Ostrea mordax* last described, it is usually attached by the left valve. The colour of the shells of this species are (*sic*) also very distinct, being of a uniform greyish-white externally, and greenish within, the characteristic purple tints of *O. glomerata* being altogether wanting. Being too small for commercial purposes, the increase of *Ostrea crenulifera* on the banks should, as far as practicable, be kept down, as if left undisturbed it will spread over the most favourable breeding and spatting grounds, in addition to appropriating food material that would otherwise contribute to the nourishment of the more valuable species."

The species appears to be closely allied to the New South Wales *virescens* Angas, but shows more wrinkling at the edges and bolder sculpture. Again, from Port Vila, New Hebrides, there are in the Australian Museum similar specimens, but much larger.

The typical specimens from Stradbroke Island measure 34 mm. in length and 22 mm. in breadth, and the many crenulations fit very tightly, although the hinge line is very short, and the interior edges consequently do not need teeth along the hinge adjacent to the hinge.

Apparently this species lives along the reef and specimens very like the typical ones have been found on Pinnas and are easily recognizable, but the following also seems the same.

A small white Oyster lives on the branches of coral all along the Great Barrier Reef, and dead valves are commonly met with on the islet beaches.

The shell is subcircular to elongate, the latter shape due to environmental conditions, greenish white, thin, cup fairly deep, upper valve flattened, edge more or less wrinkled, umbonal triangle long. Plate VII, fig. 1*a*, shows a group of these coral-living oysters on a piece of coral, and although these at first sight look different, the differences seem to be due to the environment only. In the same locality more or less normal specimens may be found alongside when the location permits. The figured specimen is from North-West Islet, Capricorn Group, Queensland.

Ostrea procles sp. nov. (Plate VII, fig. 2.)

1906. *Ostrea cerata* Hedley, Proc. Linn. Soc. N.S.W. XXXI, p. 464 : Mast Head Reef, Capricorn Group, Queensland.
Not *O. cerata* Sowerby, Conch. Icon. (Reeve), XVIII, pl. xxviii, sp. 71, November, 1871 : Diego Marcia, Mauritius.

Shells of medium size, very flattened, irregularly subcircular, attached by almost the whole of the lower valve. There is no definite sculpture visible, as the whole of the upper valve is covered and honeycombed by growths that cannot be cleaned off. The outer surface is yellowish white, the inside chalky white, the muscle scars showing a purplish tinge ; an upraised rim surrounds the animal, and near the hinge there is a wrinkled, toothed edge on each side. The hinge is very broad, but the hinge plate shallow. The lower valve shows only an indefinite radial folding and concentric growth-lines.

Length 50 mm., breadth 50 mm.

Living under coral blocks at Low Isles, Michaelmas Cay, and is easily recognized by its very flattened shape and colour.

Ostrea quirites sp. nov. (Plate VII, fig. 3.)

1891. *Ostrea sellaformis* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 4, pl. iv, figs. 4, 5, *ante* November : Moreton Bay, Queensland.
1893. *Ostrea sellaeformis* Saville-Kent, Great Barrier Reef, p. 250, Chromo-plate xiv, fig. 6.
Not *O. sellaeformis* Conrad, Fossil Shells, pl. xiii, 1833.

This species was well described, figured and distinguished by Saville-Kent, but he selected an invalid name, so it must be re-named. It is commonly dredged throughout Queensland, and is generally adherent only by the umbo to other shells. It grows to a fairly large size, and appears to be closely related to the preceding, so that it might be regarded as a deeper water representative.

Good specimens have long distant tubular spines on obsolete ribs, the saddle-shape being very pronounced; through living on a muddy bottom the shells are attached, generally with a small portion only, to stones or other shells, the spines being developed equally on both valves. Young specimens showing about eight uneven rounded distant ribs from which hollow spines arise at intervals, the lower valve showing similar ribbing, while the saddle-shape has not yet been developed. It is longer than broad, but adults are subcircular, broader than long with deep median depression. Coloration is greenish-white ; inside white, border green, muscle scars white. The hinge is broad, the hinge plate short.

The largest specimen is one dredged in Port Curtis in about 9 fathoms by Messrs. M. Ward and W. Boardman ; this measures about 125 mm. in height, and about the same in breadth ; in this shell the hinge line is about 35 mm., and the area enclosed by the upraised rim is comparatively small, being about 70 mm. at its widest and about 85 mm. in extreme length.

Ostrea bresia sp. nov. (Plate VII, fig. 4.)

1882. *Ostrea imbricata* Cox, Proc. Linn. Soc. N.S.W. VII, p. 131, 23rd May : Port Denison, Queensland.
Not *Ostrea imbricata* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 213, July, 1819 : Mers de Java.
1893. *Ostrea circumsuta* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 2.

The shell is nearly circular, somewhat notably folded and peculiarly coloured, more or less free, flattened. There are no distinct crenulations near the hinge, the internal

coloration being opalescent white, with patches of green and purple showing through, bronze red outside. The subangulate radial folds number four or five, and the upper surface sculpture consists of rather distant, very thin, lamellose layers. The hinge-line is very short, scarcely exceeding the hinge plate. The lower valve is scarcely adherent, and showing the same radial folding and lamellae as the upper valve, also has a strong tendency to develop tubular projections, which may be used for attachment to mangrove roots.

Length 55 mm., breadth 55 mm. ; from Seaforth, north of Mackay. Many larger specimens have been found along the coast of Queensland.

This curious Oyster has the appearance of a degenerate *Lopha*, but Mr. T. C. Roughley has found that it is larviparous, therefore referable to *Ostrea* s.l., but its radial folding, its bronze colouring and its opalescent interior demand its separation with subgeneric rank, *Pretostrea*. This is apparently the Oyster Saville-Kent refers to as follows : " A small, corrugated, red-shelled oyster that grows sparingly in deep water in various parts of Moreton Bay is known technically by the title of *Ostrea circumsuta*." No other Oyster answers to such a description, but this is certainly nothing like *circumsuta* Gould.

Ostrea sedea sp. nov. (Plate VII, fig. 5.)

A very small Oyster was found under stones at Lindeman Island, Whitsunday Group, Queensland, and criticism indicates that it is adult. It does not correspond with the juvenile of any known species, so is here described.

Shell very small, flat, adherent, subcircular ; edge of lower valve upraised, dull cream ; dead shells yellowish white. The upper valve shows strong flaking, and is comparatively thick, the muscle scar large, and greenish in colour. The hinge line is short, and there are no crenulations present. Valves had been commonly found at Michaelmas Cay, Low Isles, etc., but had been disregarded as juvenile. Length 20 mm., breadth 14 mm.

The flaking of the upper valve is characteristic.

Genus *Saxostrea*.

1936. *Saxostrea* Iredale, Rec. Austr. Mus. XIX, p. 269, 7th April.
Orthotype : *Ostrea commercialis* Iredale and Roughley.

This genus was diagnosed : " Small to medium-sized Oysters, the lower valve deep and sometimes cup-shaped, the upper valve flattened ; adherent to rocks by the greater part of the lower valve ; generally deeply coloured, bluish to black ; the hinge line short, the hinge plate medium, the internal edges of valves more or less crenulated. The juvenile is rounded and flattened, sometimes spinose, but the spines disappear with age, and commonly a radially crumpled sculpture is seen in the adult. The animal is dioecious, the egg small, the adult non-larviparous."

Saxostrea commercialis Iredale and Roughley, 1933.

1891. *Ostrea glomerata* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), pp. 1, 4, pl. i, figs. 1–9 *ante* November.
1893. *Ostrea glomerata* Saville-Kent, Great Barrier Reef, p. 243, Chromo-plate xiv, figs. 8–11.

The Queensland shell appears to be the same as the New South Wales species, which was recently described as *Ostrea commercialis* by Iredale and Roughley (' Proc. Linn. Soc.

N.S.W.' LVIII, p. 278, 15th September, 1933). This was introduced with the following details: " The common oyster of New South Wales has borne several scientific names which will be discussed in a complete account of the oysters of Eastern Australia, prepared by us but not yet published. This preliminary note is written to establish the new specific name *commercialis* proposed for this species. It has been called *cucullata* Born, introduced for a shell from Ascension Island and the West Indies; it has been regarded as *mordax* Gould, a 'Feejeean' form; the name *glomerata* has sometimes been pressed into use, though that is strictly a Neozelanic species; again *circumsuta* Gould has even been suggested, also described from the Feejees and Samoa; while at other times *subtrigona* Sowerby and also *mytiloides* Lamarck have been advanced as substitutes."

The description reads: " Normally this oyster is small, adherent, the lower valve rather deep, the upper valve nearly flat, both valves radially crumpled. Coloration bluish externally, whitish internally, juvenile specimens commonly showing radial flames on a bluish ground. The hinge plate is of medium extent, the hinge-line short; edges of valves internally more or less crenulated. The juvenile is flattened and nearly circular, the ultimate shape depending on environmental stresses; with free growth the lower valve, which is attached, grows upward more or less regularly, forming a deep cup with regularly crinkled edges. If growing in crowded situations the growth becomes very irregular and often stunted, while on the open sea coast it is commonly stunted and distorted owing to the prevailing high salinity which retards growth development. Under such conditions the internal edges tend to develop rather strong teeth."

Succeeding this note, Roughley discussed " The Life-History of the Australian Oyster (*Ostrea commercialis*) " (*loc. cit.*, pp. 279–333, plates x–xxvii, 2 text-figs.), dealing especially with the form about Sydney, New South Wales, giving as range, " confined to the eastern Australian coast, its range extending from the far North Queensland coast to as far south as Wingan Inlet in Victoria ".

Owing to its response to environmental stresses this species shows a great deal of variation, yet when studied closely it does not seem really to alter much.

A very curious form which has been considered even as a distinct species occurs in shallow water; this is here figured from a specimen from Lindeman Island, dredged, which agrees very well with the Moreton Bay specimens discussed below.

Saville-Kent wrote: " Fig. 4 has been chosen to illustrate a form very prevalent among the oysters from deep water or dredge sections, and in which the prolongation and smoothness of the component shells are more conspicuously pronounced than in the typical dredge or drift variety. . . . This abnormal elongation, it would seem reasonable to anticipate, exhibits a disposition on the part of the mollusc to grow upwards towards the light, much after the manner of a light-starved plant. That this tendency to elongate may be manifested at an early period in the oyster's life is well shown by the brood-cluster represented at Fig. 5 . . . in which a number of slender elongated shells are attached vertically to the dead valve of a *Parallelopipidon*. These young oysters were dredged from a depth of 4 fathoms in Moreton Bay. The same dredge haul that yielded these specimens brought up, however, a much more considerable number of brood agreeing strictly in contour with the typical form of *Ostrea glomerata*. Adult clusters obtained from a similar depth, moreover, containing the normal and the elongated modification in the same group."

On the other hand, shells living on the seashore under blustery conditions are small and stunted, thickened and with the inner edges of the valves strongly nodulated, a feature almost missing in the normal shell. This has been commonly called " *circumsuta* ", and at the first sight it seems quite a recognizable form. It may later be named ecologically, but as Queensland forms have not been studied that may be attended to later. On the other hand, the ecomorph figured (Plate VII, fig. 6) from Lindeman Island, and described by Saville-Kent from Moreton Bay, has not yet been recognized in southern waters, so it is here named *dactylena* ecomorph nov.

"*Ostrea spinosa.*" (Plate VII, fig. 7.)

An Oyster has been sometimes recorded as *Ostrea spinosa*, but that name was apparently based on the immature spiny juvenile shell sometimes met with in this group. Quoy and Gaimard ('Voy. de "l'Astrol.," Zool. Atlas', pl. lxxvi, figs. 13–14) described an Oyster as " Huître epineuse ", but the plate was issued in 1834 with the name and locality, but no Latin equivalent. Deshayes, working at the second edition of Lamarck's ' Histoire Anim. s. Verteb.', included this, giving a good description from the shells that had been deposited in the Paris Museum (with Quoy and Gaimard's consent) and latinized the name as *Ostrea spinosa* (Vol. VII, p. 237). This was not issued until January (23rd), 1836, and in the meanwhile the text of the 'Voyage "Astrol.," Zool.' had been produced, and therein Quoy and Gaimard (Vol. III, p. 455) had used the name *O. echinata*. The locality was " Île d'Amboine " and the adult may even be *O. parasitica* Gmelin = *mytiloides* Lamarck, but nothing at present is certain.

This curious aberration is not uncommon in Queensland, and is here figured, but it has neither subspecific nor ecological significance as far as is known yet.

Saxostrea amasa sp. nov. (Plate VII, fig. 8.)

1891. *Ostrea mordax* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 2, pl. ii, figs. 1–4 : Coral Reefs of Queensland.
1893. *Ostrea mordax* Saville-Kent, Great Barrier Reef, pp. 65, 245, Chromo-plate xiv, figs. 1, 2.

The typical form of the Sea Oyster here shown is unmistakable, and generally this is normal, the shape being sometimes compressed through conditions, but then the external sculpture is diagnostic. The type is from Caloundra, but it is commoner further north.

Saville-Kent's remarks are complete : " The characteristic features, in its most typical form, are its normally elongate triangular contour, the very evenly lobate edges of the interlocking shells, and the opaque purplish-pink hue of their external surface . . . may be said to attain to its finest or maximum development among the coral reefs and islets of the tropical coast-line of eastern Australia, and from its remarkable abundance in this region it may appropriately [be] distinguished by the popular title of the Coral Rock Oyster. In contradistinction . . . is an essentially marine type, attaining to its most luxuriant growth . . . far remote from fresh water. . . . I have not obtained information concerning any instance in which this oyster has been found growing beneath, or even at, as low a level as ordinary low tide mark ".

Saxostrea (*cornucopiaeformis*) Saville-Kent, 1893. (Plate VII, fig. 9.)

1891. *Ostrea cornucopia* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 3, pl. iv, figs. 2–4, *ante* November : Rocky Island off Keppel Bay, Queensland.
Not *O. cornucopiae* Gmelin, Syst. Nat. VI, p. 3336, 1791.
1893. *Ostrea mordax* var. *cornucopiaeformis* Saville-Kent, Great Barrier Reef, p. 248, Chromo-plate xiv, figs. 3, 4.

Whether this curious modification belongs to either of the Queensland Rock Oysters or to both is not yet absolutely known. Saville-Kent referred it to the Sea Oyster, but the specimen here figured seems to be more like the Commercial Oyster. Under the circumstances it is being recorded here without prejudice.

Saxostrea gradiva sp. nov. (Plate VII, figs. 10, 10*a*, 10*b*.)

1891. *Ostrea nigromarginata* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 2, pl. iii, fig. 1 ; pl. iv, fig. 1, *ante* November : Adolphus Island, Torres Straits.
1893. *Ostrea nigromarginata* Saville-Kent, Great Barrier Reef, p. 245, chromo-plate xiv, fig. 7
Not *O. nigromarginata* Sowerby, Conch. Icon. (Reeve), XVIII, pl. xxxiii, sp. and fig. 85, November, 1871 : Arakan.

Shell very large for this genus, ponderous, subcircular, cup fairly deep when adult, coloration outside blackish blue, inside bluish or chalky white, with very broad blue-black margin. The juvenile shell is flattened, like that of all species of *Saxostrea*, with the hinge plate narrow, the beak very slight. The inner edges denticulate, the denticles fairly close near the hinge, becoming more distant and disappearing towards the front. In the adult these have become obsolete through continued layers of shell until only a few remain near the hinge. The muscle scar is greenish to white, not blue. The surface sculpture is composed of closely-packed layers of thin laminae, which project to form a tenuous edging. This delicate margin is seen in old, otherwise very crass, individuals, and is gently wavy, but never strongly dentate. The lower valve is strongly adherent when the specimen is young, but with age the edges become more erect, showing regular growth-lines.

Saville-Kent's notes are excellent : " Is an essentially marine type, and limited in its distribution to the tropical districts. It varies considerably in form, and may be either simply ovate, with a broader distal margin, or boat-shaped with pointed ends. The larger individual shells of this species not unfrequently measure as much as 6 or 7 inches in their longest diameter. Its edges in contradistinction to the preceding species (*cris-tagalli*), are usually perfectly even, or only slightly indented. A notable feature of this oyster is the very hard vitreous texture of its shell. Its colour externally is usually a light slaty-grey, and, interiorly, a pure white with a very conspicuous broad black band throughout its marginal border. While by no means an unpalatable oyster in the raw condition, it, like the preceding species, finds greater favour in a stew or scallop."

The figures show an adult with the upraised rim growing freely on rock, 10*a*, the immature growing freely before the edge turns up, and 10*b*, the shell growing lengthwise on a mangrove root, as common at Low Isles.

Genus *Lopha*.

1798. *Lopha* Bolten, Mus. Bolten, II, p. 168, September.
Logotype (Dall, Trans. Wagner Free Inst. Sci. Philad. III, pt. 4, p. 671, April, 1898): *Ostrea cristagalli* Linné.
1807. *Alectryonia* Fischer de Waldheim, Mus. Demid. III, p. 269.
Logotype (Dall, Trans. Wagner Free Inst. Sci. Philad. III, pt. 4, p. 671, April, 1898): *Ostrea cristagalli* Linné.
[1850. *Rastellum* Mörch, Cat. Conch. Kierulf, p. 26 (pref. 29th October).
Haplotype: *Ostrea plicata* Chem. = *Ostrea plicatula* Gmelin.
1897. *Alectryonella* Sacco, I. Moll. ter. terz. Piemonte e Lig. XXIII, p. 19, June.
Orthotype: *Ostrea plicatula* Lamarck = Gmelin.]

Large Oysters, with edges very deeply cut angulately, almost free, when adherent only by means of projections, thin. Very little is known about these large Oysters, but they are very distinct superficially from any of the small forms, and even when members of the genus *Saxostrea* reach a very large size, there can never be any confusion.

Lopha cristagalli Linné, 1758.

1758. *Mytilus cristagalli* Linné, Syst. Nat. 10th ed., p. 704, 1st January, based on Rumph. Mus. t. 47, fig. D; Gault. Test. t. 104, figs. C, D, E, and Argenv. conch. t. 23, fig. D. Habitat in O. Indici Gorgoniis.

This name is used for the true Cockscomb, the thin rather delicate shell with the very acutely-angled edge, and the projecting lower prongs with which it clings to its support. It is always found below low water, never above, and is therefore not commonly met with.

Lopha hyotis Linné, 1758.

1758. *Mytilus hyotis* Linné, Syst. Nat. 10th ed., p. 704, 1st January, based on Rumph. Mus. t. 47, fig. C, and Argenv. Conch., t. 23, fig. H: In Pelagi Gorgoniis.
[1797. *Ostrea gigas* Humphrey, Mus. Calonn, p. 53: new name for *Mytilus hyotis* Linné.]
1871. *Ostrea hyotis* Sowerby, Conch. Icon. (Reeve), XVIII, pl. iv, sp. 7: Indian Ocean.
1891. *Ostrea cristigalli* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 1, pl. iii, fig. 2.
1893. *Ostrea cristagalli* Saville-Kent, Great Barrier Reef, p. 244, Chromo-plate xiv, fig. 5.
Not *Ostrea cristagalli* Linné, *ante*.

Very large, ponderous Oysters, with strongly dentate margin, rather deep cut, blue colouring outside, whitish inside, with margins blue-black and muscle scar large, curiously elevated, forming a sloping shelf-like projection. Solitary in growth, adherent basally, edges upstanding, recalling *cristagalli* by the strongly angulately cut edges, this species may not be closely related. Found on Low Isles and Batt Reef.

It must be remembered that Saville-Kent confused this with the true Cockscomb and used the name *cristagalli* for it. Again, Saville-Kent's notes cannot be improved upon: "The largest edible form of oyster found in Queensland waters is distinguished by the title of the coxcomb oyster—*Ostrea cristi-galli*—so-called from the regular zigzag undulations of the outer edge of its interlocking valves having some resemblance to a coxcomb. A pair of the ponderous shells of the coxcomb oyster not unfrequently weigh as much as from 5 to 7 lb., and have a diameter of from 8 to 12 inches. The species is an

essentially salt-water form, and limited in its distribution to the tropics. It grows plentifully among the coral reefs of Torres Straits and the Great Barrier system in either an entirely submerged condition, or, where exposed to atmospheric influences, at ordinary spring tides. Under these last-named conditions I have observed it in especial abundance on the fringing coral reefs surrounding what are known as M and N Islands, belonging to the Northumberland Group, eastward of Mackay. This oyster is also to be seen in some quantities *in situ,* but no longer alive, on the dead and apparently raised coral reef on the west side of Magnetic Island, facing Townsville. As an edible variety the coxcomb oyster is somewhat large and coarse, and is consequently most appreciated in a cooked condition."

Genus *Dendostraea.*

1835. *Dendostraea* Swainson, Elem. Conch. p. 39 (*genus caelebs*).
1839. *Dendostrea* Sowerby, Conch. Man. 1st ed., p. 137, *ex* Swainson.
Haplotype : *Ostrea folium,* fig. 181.
1840. *Dendrostraea* Swainson, Treat. Malac. p. 389, May.
Logotype : Gray, Proc. Zool. Soc. (Lond.) 1847, p. 201, November. *Ostrea folium.*

Small elongated oysters, with crumpled edges adherent to branches or stems, which are clasped by projections from the lower valve. The animal is not known, as the species is only dredged, but the characters of the shell are very constant, and this cannot be confused in any way with either *Lopha* or *Saxostrea.*

Dendostraea folium Linné, 1758. (Plate VII, figs. 11, 11*a.*)

1758. *Ostrea folium* Linné, Syst. Nat. 10th ed., p. 699, 1st January, based on Rumph, pl. xlvii, fig. A = Amboina.
1891. *Ostrea folium* Saville-Kent, Queensland Govt. Report (Oysters and Oyster Fisheries), p. 2.
1893. *Ostrea folium* Saville-Kent, Great Barrier Reef, p. 244.

Saville-Kent wrote : "A smaller variety of coxcomb oyster is not infrequently obtained from deeper water in Torres Straits attached to the branches of the black coral, *Antipathes,* and other zoophytes. It is remarkable for its production of finger-like projections from the back of the attached valve. With the aid of these projections it retains a secure grasp on its chosen fulcrum, though at the same time the hold may be so loose that the shell may be slipped to and fro on its supporting base. This variety of oyster would appear to be identical with the *Ostrea folium* of Linnæus originally reported from the Indian Ocean."

The figures from above and below are taken from a specimen dredged at Low Isles.

[*Ostrea tuberculata.*

1899. *Ostrea tubercularis* Melvill and Standen, Journ. Linn. Soc. (Lond.) Zool. XXVII, p. 181 : Albany Passage, Torres Straits, Queensland.
1909. *Ostrea tuberculata* Hedley, Rep. Austr. Assoc. Adv. Sci. (Brisbane), p. 345.

Hedley's inclusion in the Queensland list was merely due to the above record of Melvill and Standen, but what these latter authors intended is very problematical. Lamarck's *O. tuberculata* ('Ann. Mus. d'Hist. Nat. Paris,' IV, p. 358, pl. lxvii, fig. 2 [not 1, as given in text], 1804) was described from Timor, collected by Péron. Lamy states that

the specimen in the Paris Museum is ticketed "Nouvelle Hollande", but he gives as measurements "73 by 54 mm.", whereas Lamarck wrote, "longue d'un decimétre (environ 3 pouces 8 lignes), sur 6 à 7 centimètres (près de 2 pouces et demi) de largeur".

Order PARAFILIBRANCHIA.

This is proposed for the section of the "Filibranchia" of Winckworth covering his family Anomiidae and similar molluscs. Thiele has called this series a Stirps Anomiacea, placing it under the Order Anisomyaria, again following Cossmann and Peyrot, who, however, associated it with the mussels as a Suborder Subfilibranchiata. This Order is divided into two families, the Anomiidae and the Placunidae, the former, the false Window Pane Oysters, adherent by means of a muscle through a hole in the lower valve, the latter, the true Window Pane Oysters, living free.

Family ANOMIIDAE.

From examination of these shells and their habits, it is difficult to conceive anyone associating them with the Arks. The texture is very thin, foliaceous, transparent, growing in a circular manner, with a small hinge, never multidentate, with muscles and gills formed upon a different fashion, and always very flattened. All are adherent with a byssus through a hole in the lower valve, the byssus generally solid and somewhat calcareous, the lower valve very thin.

Genus *Patro*.

1850. *Patro* Gray, Proc. Zool. Soc. (Lond.) 1849, p. 118 (*ante* June), 1850.
Haplotype: *Anomia elyros* Gray.
Spelt *Patros* on Moll. pl. iv.

Gray's definition of the section reads: "Two upper scars small; lower one large. Shell suborbicular; sinus small." The upper scar is semicircular, the diameter marginad, the next one is circular, not quite as large as the upper (completed) one would be, while the third is much larger and circular and distant, the whole being enclosed in a tongue-shaped patch of opaque white contrasting with the subnacreous remainder of the upper valve. In the lower valve the aperture is not quite complete as a rule, the edges overlapping, the hole small and oval, the plug thin and shelly. The opaque white patch on the lower valve is much rounder than the one in the upper valve, and shows one large circular muscle scar agreeing with the lowest of the upper three.

Patro australis Gray, 1847.

1847. *Anomia australis* Gray, Narr. Voy. "Fly" (Jukes), II, App. p. 362: Port Essington, North Australia.
1850. *Anomia elyros* Gray, Proc. Zool. Soc. (Lond.) 1849, p. 118, *ante* June, 1850, Moll., pl. iv, figs. 1, 2: Port Essington, North Australia.

At the first reference the description reads: "Shell suborbicular, straight above, and slightly eared on each side, opaque white, the upper valve convex, with numerous nearly regular radiating ribs, which become evanescent (perhaps from wearing) near the margin.

Under valve concave, greenish. The perforation or anterior notch small, oblong. The plug shelly.

"INHAB.—Port Essington, adhering to rocks."

A little later, Gray, reviewing the species of Anomiidae, introduced *Anomia elyros*: "White, lamellar, closely radiately striated. The disc of the upper valve with three separate subcircular scars; the two upper scars small, subequal, one under the other; the lower one large, nearly circular, subcentral. Notch in lower valve very small. Plug small, elongate, subcylindrical; the notch small, with reflexed edges. Hab.: Port Essington; Earl of Derby."

These two descriptions, although reading so differently, are based on the same species, even the same specimens.

Although these shells are found all round the northern coast to Shark's Bay in the west and Port Curtis on the east, no appreciable difference has yet been noted.

It is somewhat difficult to separate in Southern Queensland specimens of the juveniles, which appear to be very close to those of *Anomia descripta* Iredale ('Rec. Austr. Mus.' XIX, p. 270, pl. xx, fig. 6, 7th April, 1936) described from Sydney. A medium-sized shell from Moreton Bay is certainly referable to the latter rather than to *Patro australis* Gray.

Shirley added *Anomia achaeus* Gray to the Queensland list as coming from Thursday Island, but that is a locality of little credence on account of the cosmopolitan population. *Anomia achaeus* was introduced by Gray ('Proc. Zool. Soc. (Lond.)' 1849, p. 116 (*ante* June, 1850) for a species from Kurachee, Mouth of the Indus, Indian Ocean, so the specific name can be dismissed at once, but there is a small *Anomia* living on the North Queensland coast which may be described later.

Genus *Monia*.

1850. *Monia* Gray, Proc. Zool. Soc. (Lond.) 1849, p. 121, *ante* June, 1850.
Logotype: Kobelt Illust. Conch., pt. XI, p. 376, 1881, *Anomia zelandica* Gray.

There is a perplexing situation regarding this name, as it was introduced as a section of *Placunanomia* with the diagnosis—"Shell ovate, not plicated; radiately ribbed. Perforation of lower valve large, only slightly embracing the large thin plug". The first-mentioned species were *P. macrochisma*, *cepio* and *alope*, American forms; then followed *patelliformis*, the European representative, and then as Australian, *zealandica*, *ione* and *colon*.

Although obviously the typical form was *macrochisma* no type appears to have been selected for thirty years, when Kobelt named *zelandica*.

Monia timida sp. nov. (Plate VI, fig. 16.)

Shell small, thin, flat, subcircular, white, delicately rayed with very fine radials showing minute scales marginad. The nucleus of the shell is very small and smooth, and in the adult the umbo is a little distant from the dorsal margin; in the early stages a few distant obsolete radials can be distinguished, but often the shell appears smooth; the fine radials number about five to a millimetre and the scales about the same ratio.

The lower valve is adherent by means of a horny plug, and when secured is found to be very thin, smooth, showing concentric growth lines only, unless repeating the sculpture

of the object to which it is attached, in which case the upper valve may also conform to the sculptured surface. The interior tinged with greenish. Length 19 mm., breadth 19 mm.

Not uncommon in the dredgings at Low Isles. Since it has been found commonly in dredgings from Lindeman Island.

Monia ione Gray, 1850.

1850. *Placunanomia ione* Gray, Proc. Zool. Soc. (Lond.) 1849, p. 123, *ante* June, 1850 : Sydney, Australia (Strange).

This appears in Hedley's list on account of Melvill and Standen's record from Mer Island, Torres Straits, where it does not occur. It may occur, however, at Moreton Bay, but all the northern dredged specimens belong to the preceding species, and shells have not yet been found on the littoral.

Placunanomia australica Reeve (' Conch. Icon.' XI, pl. iii, figs. 13, 13*a*, June, 1859), described from Australia only, appears to be based on a juvenile of this species.

Genus *Enigmonia*.

1918. *Enigmonia* Iredale, Proc. Mal. Soc. (Lond.) XIII, p. 31, " August " = 9th September.
New name for—

1850. *Aenigma* Gray, Proc. Zool. Soc. (Lond.) 1849, p. 114 (*ante* June, 1850), *ex* " Koch MS."
Orthotype : *Anomia rosea* Gray.
Not *Aenigma* Newman, Entom. Mag. V, ser. iii, p. 499, April, 1836.

Very little is known about these delightful little Anomioid forms either as to range, distribution, species or economy, while anatomically they might prove very interesting. As far as can be seen they all live among mangroves, some fixing themselves to the large roots, others to the thinner rootlets, while some live on the leaves, and not much more information is available. When living on the large roots they are broadly oval, on the thinner rootlets they assume an elongated narrow form, while on the leaves they are small and oval and very flattened, though all are flattened. The bronze-red coloration appears characteristic, being paler or greener on the leaves.

The history of the genus *Aenigma* is given below, but the problems of the different species are yet unsettled. The generic name *Aenigma* Koch was rejected by me (' Proc. Mal. Soc. (Lond.) ', XIII, p. 31, " August " = 9th September, 1918), and the name *Enigmonia* proposed in its stead. I wrote, " *Aenigma* is credited to Koch, 1846, the quotation (incomplete) referring to Martini and Chemn. Cont. lief. 56, band VII. I have been unable to trace this ". Sherborn had been also unable to find the reference, and in the ' Nomencl. Anim. Gen. et Subgen.' p. 67, 1926, there appears, " *Aenigma* . . . Koch in Martini and Chemnitz, ' Conch. Cab.' v. 7, t. 7, 1846 ". This is also incorrect, as it is well known that there are no scientific names on the plates of this publication.

In the Australian Museum the copy of the ' Conch. Cab.' still retains the original text solving the problem. In Band VII, Abteilung 1, is an unnumbered sheet of " *Aenigma* n.g." signed by " Koch, October, 1846 ". That this was issued at the time is proved by a review by Pfeiffer (' Zeitschr. für Malak.,' November, 1846, p. 175), who wrote : " In der 56sten Lieferung (of Die neue Ausgabe des Martini-Chemnitz'schen

Conchylien-Cabinets) eine vorläufige Monographie der interessanten, von Hrn. Bergrath Koch zu Grünenplan daselbst zuerst aufgestellten und charakterisirten Brachiopoden-gattung *Aenigma*, welche auf *Tellina aenigmatica* Chemn. gegrundet ist. Es finden sich dort 4 wohl unterschiedene Arten der Gattung beschrieben und auf Taf. VII, 1, N. 7 vortrefflich abgebildet."

The sheet is apparently very rare, and the text deals with :

"(1) *Aenigma roseum* Gray (Taf. 7, fig. 1 Ober-, 2 Unterschale, 3, 4, 5 verschiedene Altersstufen von oben und unten).

Ostindien teste Chemnitz et Anton. Philippinen teste Cuming . . . erhalten habe.

(2) *Aenigma reticulatum* mihi (Taf. 7, fig. 8 Ober- u. Unterschale).

Philippinen von Cuming erhalten.

(2) (*sic*) *Aenigma convexum* mihi (Taf. 7, fig. 9 Oberschale, 10 dieselbe von der Seite, 11 Unterschale, 12 Innenseite der Oberschale).

Ein Exemplar unter Ostindischen Conchylien gefunden; ein anderes im Wege des Handels angeblich von den Sandwich-Inseln.

(3) *Aenigma corrogatum*, mihi (Taf. 7, fig. 13 Oberschale, 14 Unterschale, 15 Oberschale von innen).

Angeblich von den Sandwich-Inseln."

Nearly forty years later the complete part was issued and the text credited to Koch and the names also, but without reference to their prior issue in 1846.

Enigmonia aenigmatica Sowerby, 1825.

Chemnitz ('Syst. Conch. Cab. (Martini),' XI, p. 211, pl. cxcix, figs. 1949–50, 1795) introduced the name *Tellina aenigmatica* for a single valve from the East Indies. As Chemnitz was non-binomial it was necessary to find the earliest user, and this appeared to be Gray, who named Chemnitz's species *Anomia rosea* ('Annals of Philos. (Thomson),' n.s., IX, p. 139, February, 1825). Since then, however, I have found that Sowerby ('Cat. Shells Coll. Tankerville,' p. 28, January, 1825) had proposed *Anomia aenigmatica* for the same figures, and, moreover, that Mawe ('Linn. syst. Conch.' p. 68, 1823) had anticipated Gray in the proposal of *Anomia rosea* for a different shell. As noted above, Koch, in 1846, introduced three other names for the different forms found, recording these from the Philippines and the Sandwich Islands. In 1859 Reeve ('Conch. Icon.' XI, pl. viii, sp. 37, figs. 37, 38, 39, 40*a–d*, August, 1859) included all the varieties under the name *Anomia aenigmatica*, including as synonym *Anomia naviformis* Jonas ('Proc. Zool. Soc. (Lond.)' 1846, p. 121, 26th January, 1847, locality unknown) without recording any of Koch's names, though these should have been available in the Cuming Collection. A very broad shell was from Borneo (p. 38), an oblique one from Singapore (fig. 39), while all the others were apparently from the Philippine Islands. A very elongate shell (fig. 37) was figured as *naviformis* Jonas.

Although this curious dweller on mangrove roots, branches and even leaves was not collected at Low Isles, it almost certainly lives there. It has been found very rarely in Australia, as it must be very difficult to distinguish in life. Rainbird collected living

specimens in the vicinity of Bowen ; these are elongate " *naviformis* ". Banfield sent a similar valve from Dunk Island. Whitley and I picked up another valve of the same shape at Michaelmas Cay—a puzzle of disposal. Recently I was fortunate enough to find two valves on the beach at Seaforth, north of Mackay, one of which is elongate, but a little broader than the two preceding valves ; the other is very thin, pale, transparent horn and apparently had been living on a mangrove leaf. This shows the immature state clearly, and it is seen to be very finely concentrically striate, later a faint radial rib begins, but this concentric striation has been seen in most of the shells, though its origin was not definite, as the superficies follows the growth lines of the root or branch the shell is living upon.

A similar elongate shell on a root is from Port Essington, Northern Territory, but Mr. A. A. Livingstone picked up a valve at Port Darwin, which is one of the broad type, and another from Broome, North-West Australia, is large and broad, measuring 46 mm. in length and 30 mm. in breadth, the surface being irregularly wrinkled.

Family Placunidae.

The Window Pane Oysters appear in Hedley's Queensland list as two species, *Placenta placenta* Linné and *P. lobata* Sowerby, the latter having been recorded by Melvill and Standen from Torres Straits. In his Addendum Hedley added *Placuna sella* Gmelin and *P. papyracea* Lamarck. While most of the species are flattened, one at least is strongly saddle-shaped, and the latter has generally been regarded as indicating a different generic or subgeneric form. Prashad (p. 30) has concluded: "The differences between the shells of the so-called genera *Placenta* and *Ephippium* Röding (= *Placuna* of authors) are not so important as to allow of their being considered as distinct genera ; they may, at most, be regarded as two subgenera of the genus *Placenta*." In this case the prior usage of *Placuna* is overlooked, and the difference in shell-formation is accompanied by distinct animal evolution, as evidenced by Stoliczka's note (' Mem. Geol. Surv. India ', ' Palaeont. Indica ', ' Cret. Fauna S. India', III, p. 450, 1st August, 1871), when he introduced *Placunema* for the species *ephippium* : " *Placuna* is found on sandy shores and has a very extensible vermiform foot with which it can bury itself partially in the sand, spinning at the same time a few threads of byssus. *Placunema* (*i. e. Ephippium* hodie) I found loosely lying on coral reefs."

Stoliczka (p. 431) notes that Deshayes concluded that the generic name *Placuna* could not be attributed to Solander, and that it should be regarded as of Bruguière. He then utilized Bruguière's name in preference to Retzius's *Placenta*, though the former had been proposed four years later, on the score that Retzius's name was preoccupied by Klein, who had published it twenty-four years before the issue of Linné's 10th edition of his ' Systema Naturae '.

However, *Placuna* goes back to Solander, so that the name is still available as the generic name and basis of the family name.

As above noted two apparently different-looking forms appear in the family :

Flat . . . . *Placuna*.
Saddle-shaped . . . . *Ephippium*.

However, there is a species, *lobata*, which is flat and also tends to irregularity in form, while the hinge also seems to vary inconsistently.

Genus *Placuna*.

1786. *Placuna* Solander, Cat. Portl. Mus. p. 16, 8th April.
Haplotype : *Anomia placenta* Linné.
1788. *Placenta* Retzius, Diss. Hist. Nat. Nov. Test. Gen. p. 15.
Tautotype : *P. orbicularis* = *Anomia placenta* Linné.

This is the flat, orbicular shell with the narrow hinge teeth, but similar flat shells have wide hinge teeth, so that this feature cannot be used in a differential diagnosis. The shell is large, subcircular, very thin and glassy, the upper valve slightly convex, the lower valve quite flat ; hinge peculiar, something like that of an *Isognomon*, a series of ligamental pits with one median one, and then on each side a curved rib extending inwards, bearing a strong ligament. A large central muscle scar is seen, and the edges of the valves are thin and fragile.

Shell orbicular, hinge teeth adjacent . . . . *placenta.*
Shell orbicular, hinge teeth wide apart . . . . . . *lincolnii.*
Shell irregular, hinge teeth wide apart . . . . . . *quadrangularis.*
Shell suborbicular, hinge teeth wide apart, edges wavy, shell a little irregular . . . . *lobata.*

Placuna placenta Linné, 1758.

1758. *Anomia placenta* Linné, Syst. Nat. 10th ed., p. 703, 1st January. "In pelago" based on List. Conch, IIIB, fig. 2, C, fig. 1 ; and Gault. Test. t. 104, fig. B.
1788. *Placenta orbicularis* Retzius, Diss. Hist. Nat. Nov. Test. Gen. p. 15. New name for *Anomia placenta* Linné.
[1797. *Placuna vitrea* Humphrey, Mus. Calonn. p. 45, 1st May, new name for *Anomia placenta* Linné.]
1798. *Ephippium transparens* Bolten, Mus. Bolten, pt. 2, p. 166, September, for Chemn. VIII, t. 79, fig. 716 : "China," Tranquebar.
1826. *Placuna ovalis* Blainville, Dict. Sci. Nat. (Levrault), XLI, p. 197, 23rd September, *ex* Lesson MS. : No locality.

This species is common on some sandy beaches of the North Queensland coast, and it may differ slightly from the typical form, but series have not yet been compared.

Placuna lobata Sowerby, 1871.

1871. *Placuna lobata* Sowerby, Conch. Icon. (Reeve) XVIII, pl. iv, sp. 4, pl. v, fig. 4*b*, November : Port Essington.
1879. *Placenta planicostata* Dunker, Journ. de Conch. XXVII, p. 214, pl. ix, fig. 2, 1st July : No locality.

This species is commonly dredged along the Queensland coast.

Placuna lincolnii Gray, 1849.

1849. *Placenta lincolnii* Gray, Proc. Zool. Soc. (Lond.) 1848, p. 114, Moll., pl. i, fig. 1, 25th April, 1849 : Australia.

This occurs along the Queensland coast, sometimes on the same beaches as *P. placenta* but its relationships are not yet exactly known.

Placuna quadrangularis Retzius, 1788.

1788. *Placenta quadrangularis* Retzius, Diss. Hist. Nat. Nov. Test. Gen. p. 16, *fide* Lynge, D. Kgl. Danske Vidensk. Selskskrifter, VII, Afv. 5, pp. 3, 12, 1909.
1798. *Ephippium anomia* Bolten, Mus. Bolten, II, p. 166, September, for Chemn. VIII, t. 79, fig. 715 (Tranquebar); Knorr. Verg. II, t. 24, fig. 1, and Rumph. t. 47, fig. B.
1819. *Placuna papyracea* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 224, February–June = 31st July; L'Ocean Indien, citing Gualt. Test., t. 104, fig. B, and Chemn. Conch. VIII, t. 79, fig. 715.

Specimens referable to this species are in this Museum, from Port Curtis, but specific comparisons with typical material have not yet been made.

Genus *Ephippium*.

1798. *Ephippium* Bolten, Mus. Bolten, II, p. 166, September.
Tautotype: *E. polonicum* = *Placenta ephippium* Retzius.
1807. *Sellaria* Link, Beschr. conch. Samml. Rosb. III, p. 158, 17th May.
Tautotype: *S. polonica* = *Placenta ephippium* Retzius.
1871. *Placunema* Stoliczka, Pal. India, III, p. 451, 1st August.
Orthotype: *A. sella* Gmelin = *Placenta ephippium* Retzius.

Although this looks superficially different from *Placuna*, it will be necessary to study the animals to determine the exact relationship. The texture and sculpture appear very similar, and it seems to develop the extraordinary and well-known saddle-shape with age, and consequently should be associated entirely with *Placuna*. The hinge and muscle scars appear to be of the same origin without much alteration, but Stoliczka, who was very careful in such matters, separated them from seeing them in nature.

Stoliczka (p. 450) recorded: "*Placuna* is found on sandy shores and has a very extensible vermiform foot, with which it can bury itself partially in the sand spinning at the same time a few threads of byssus. *Placunema* I found loosely lying on coral reefs."

Ephippium ephippium Retzius, 1788.

1788. *Placenta ephippium* Retzius, Diss. Hist. Nat. Nov. Test. Gen. p. 16: Indian Ocean.
1791. *Anomia sella* Gmelin, Syst. Nat. VI, p. 3345: Oceano Indico.
1798. *Ephippium polonicum* Bolten, Mus. Bolten, II, p. 166, September, for Chemn. VIII, t. 79, fig. 714: Moluccas.

Although this is on record from Queensland, there are no local specimens available.

Order ISOFILIBRANCHIA.

This is introduced for the Mussel-like molluscs which were associated with the Arks and Window Pane shells under the general "Order Filibranchia". Thiele regarded these as a Stirps Mytilacea of his Order Anisomyaria, this Stirps agreeing with Cossmann and Peyrot's "Cénacle", a part of their Suborder Subfilibranchiata belonging to the same Order.

Family Mytilidae.

No true Mussels have yet been reported from Queensland waters, but there are many of the toothless Mytiloid forms, and these apparently represent many groups. Ihering and Jukes-Browne independently examined Mytilids, but neither had much material nor

field study. The Modiolid forms alone would be worth studying, as in nature there are different groups, and these are at present all lumped.

Genus *Trichomya*.

1900. *Trichomya* Ihering, Proc. Mal. Soc. (Lond.) IV, p. 87, August.
Orthotype: *Mytilus hirsutus* Lamarck.

This genus was proposed by Ihering for *hirsutus*, *horridus* and *tortus*, the last-named being the type of *Stavelia*, but fortunately he designated *hirsutus* as the type of *Trichomya*. I have already stated that *Stavelia* and *Trichomya* are distinct groups, the latter showing the curious discrepant sculpture characteristic of "*Musculus*", while the former is smooth. From Port Curtis, 9–12 fathoms, many specimens of *Stavelia* were dredged by Messrs. Ward and Boardman, and adherent to some were specimens of *Trichomya*.

Trichomya hirsuta Lamarck, 1819.

1819. *Mytilus hirsutus* Lamarck, Hist. Anim. s. Vert. VI (1), p. 120, July: Mers de la Nouvelle Hollande.

The species known by this name in New South Wales ranges along the Queensland coast as far north as Townsville, and southwards into South Australia, whence it may have been described by Lamarck. His description is not convincing, as the size, 62 mm., is not commonly reached, and at that size it would scarcely be termed "subtrigona", while the "latere postico depresso hiante" is somewhat disturbing.

Genus *Stavelia*.

1858. *Stavelia* Gray, Proc. Zool. Soc. (Lond.) 1858, p. 90, 27th April.
Haplotype: *Mytilus tortus* Reeve, pl. xli, fig. 1.

This well-marked group is an inhabitant of the coastal waters of Queensland, and is easily recognizable by its large size, its curious shape, its bristly exterior, the bristles carrying many hooks, and its toothless hinge.

Although the hinge is quite toothless, the edges of the valves do not crenulate at any stage; the ligament internal, rather short but stout, and carried between two projections, in the adult, almost meriting the titles of shelves.

Stavelia horrida Dunker, 1857.

1857. *Mytilus horridus* Dunker, Proc. Zool. Soc. (Lond.) 1856, p. 359, 8th May, 1857: North Coast, New Holland.

1857. *Mytilus horridus* Reeve, Conch. Icon. IX, pl. iii, sp. and fig. 9, June, 1857, as of Dunker, P.Z.S. 1856: Cape Capricorn, North Australia.

This species has been sometimes called *subdistorta* Recluz, but that species, as *Mytilus subdistortus* ('Journ. de Conch.' III, p. 159, pl. viii, figs. 6, 7, June, 1852), was described from the Seas of China with doubt. The figure shows that the species certainly did not come from Australia. This is common in the dredge along the Queensland coast, and sometimes occurs washed up on the beaches.

Genus *Modiolus*.

1799. *Modiolus* Lamarck, Mem. Soc. Nat. Hist. Paris, p. 87, May.
Haplotype : *Mytilus modiolus* Linné.
1801. *Modiola* Lamarck, Syst. Anim. s. Vert. p. 113, January.
Haplotype : *Modiola papuana* Lam. for Argenv. t. 22, fig. c, etc.
1847. *Volsella* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 198, November (as of Scopoli, Introd. Hist. Nat. p. 397, 1777 : Indeterminable).
Orthotype : *Mytilus modiolus* Linné.

The edentulous Mussels arranged under the generic name *Modiolus* may be separable when the animals are critically examined. Superficially there are distinct sections, with very probably entirely different habits, as some are found attached to stones, while others live in mud. The exterior also shows variation with regard to the hirsute covering, some very thickly covered, others almost naked. Again, there is a series in which the hinge line is long and the ligament slender and weak, as contrasting with those with a short hinge line and stout ligament. When we find that the byssus-bearing, hirsute forms are those with the short hinge line and stout ligament, and that the mud-living, naked ones have the long hinge line and slender ligament the distinction seems worthy of at least subgeneric, distinction.

Prashad (p. 71) noted that " *Modiolus* (*M.*) *elongatus* is allied to *M.* (*M.*) *philippinarum* Hanley, *M.* (*M.*) *metcalfei* Hanley, and *M.* (*M.*) *arata* Hanley, but is easily distinguished by its comparatively much elongated and narrow shell, a moderately developed post-dorsal wing and rather feeble sculpture ".

I would attach *M. elongatus* to my second group along with *arata*, and refer *philippinarum* and *metcalfei* to the first one, but discuss the two latter below.

Modiolus penelegans sp. nov. (Plate VI, fig. 17.)

This is the species most like *metcalfei*, but it is longer and narrower.

Shell elongate. If we take the hinge line as a horizontal the shell is steeply oblique, posteriorly much produced, anteriorly very slightly produced beyond the beaks, the ventral margin slightly sinuate, the dorsal strongly arched. Shell most swollen medially, flattening towards the postero-ventral end, while the dorsal angulation is sharp and the shell is there thinned. The hinge line is short and delicate. The coloration is bright shining yellowish brown, darker on the dorsal angle, with a paler band below the median swelling as well as one above. There is a thin periostracal covering of fine elongate processes on the posterior portion of the shell, but generally the shell is smooth. The longest measurement of the specimen figured, from Townsville, is 61 mm., the height 26 mm., but from the parallel of the hinge line 40 mm., the depth 23 mm.

Some years ago, from examination of the British Museum specimens, I concluded that *Modiola philippinarum* Hanley appeared to be the same as *M. metcalfei* of the same author described at the same time (' Cat. Rec. Bivalve Shells ', p. 235, Suppl. pl. xxiv, fig. 25 : ' Proc. Zool. Soc. (Lond.) ' 1844, p. 14, July), and that *M. metcalfei* had place priority, and therefore advocated its use. In very few instances have I ever advised " lumping ", and in each case more knowledge has compelled the rejection of that advice, and in this one I also erred. There can be little hesitation to-day in accepting the distinction of the two forms, and Talavera and Faustino (' Philippine Journal of Science,' L, pp. 23, 24,

pl. x, fig. 3 ; pl. xi, figs. 2, 3, 4, January, 1933) have described the two Philippine species as common and distinct, and these also obviously differ from the Australian shells. However, in the meantime, Lamy (' Bull. Mus. Nat. 'dHist. Nat. Paris,' XXVI, p. 65, 1920) had examined the type of *Modiola albicosta* Lamarck, and recorded that it was the same as *M. philippinarum* Hanley, with *M. metcalfei* Hanley, and *M. rumphii* Philippi (' Zeitschr. für Mal.' IV, p. 114, August, 1847. However, Lamarck's species was described from " les mers orientales de l'Inde, de Timor et de la Nouvelle Hollande ", not the Philippines, so that the identity with *philippinarum* is denied.

The confusion with regard to these species can be best understood by Lamy's publication of Jousseaume's notes on Red Sea Mussels. Lamy (' Bull. Mus. d'Hist. Nat. Paris,' Year 1919, No. 2, p. 110) recorded the MS. name, *Modiola vultuosa*, for the shell figured by Savigny, on plate xi, as being intermediate between *auriculata* and *philippinarum*, though, just above, he had recorded that Jousseaume suggested that *metcalfei* was only a variety of *philippinarum* approaching *auriculata*. Lamy, on the next page (p. 111), introduced *Fulgida*, *ex* Jousseaume MS., for *Perna fulgida* H. Adams (' Proc. Zool. Soc. (Lond.) ' 1870, p. 7, pl. i, fig. 9 : Red Sea), which he placed as a synonym of *M. lignea* Reeve. Cooke had previously identified H. Adams's species with *philippinarum*, and in this view he has been followed by Lynge, but *lignea* does not seem at all like *philippinarum*.

Modiolus proclivis sp. nov. (Plate VI, fig. 19.)

Approaching *philippinarum* in form, but lacking the dorsal angulation and having the major portion of the shell hirsute, but these appendages appear to be sticky and have many small particles of shell adherent.

This is comparatively a broader shell than the preceding with the shell less strongly oblique, the ventral margin a little more sinuate, and the dorsal roundly arched.

The longest measurement of the shell figured from Albany Passage is 71 mm., the height 33 mm., but from the parallel of the hinge line, 45 mm., the depth 29 mm.

This species is not met with on the beaches as is the preceding, but is dredged in shallow water from Cape York to Port Curtis.

Modiolus agripeta sp. nov. (Plate VI, fig. 21.)

This species has been called *Modiola auriculata* Krauss (' Sudafr. Moll.' p. 20, pl. ii, fig. 4, 1848), which was described from South Africa, but that name must fall before *Modiola semifusca* Lamarck (' Hist. Anim. s. Vert.' VI (1), p. 113, July, 1819: Île de France ?), according to Lamy. As, however, Lamarck's species was described from the " Cabinet de M. Dufresne ", that conclusion is doubtful, until the original specimen is re-examined in the Royal Scottish Museum at Edinburgh.

Krauss's figure disagrees with our shell, and specimens from South Africa, determined by local specialists as Krauss's species, are differently shaped and have very little periostracum, and are thinner, recalling the *metcalfei* form rather than this. Our shell is a littoral species living at Low Isles near the outer edge, where, in places, it is very abundant, forming a mat, apparently always gregarious. It is very hirsute, the processes long but simple, the shell comparatively short and broad, dorsal angle elevated, nearer the anterior than posterior end, ventral edge nearly straight, coloration pale brown. The longest

measurement of a Low Isles specimen (figured) is 45 mm., height 20 mm., from hinge parallel 32 mm., depth 20 mm.

Modiolus vagina suaviter subsp. nov.

Hedley included *Modiola vagina* Lamarck in his Queensland list, but Lamarck's species ('Hist. Anim. s. Vert.' VI, part 1, p. 112, February–June = July, 1819) was described from the Indian Ocean, 'Rumph. Mus.', t. 46, fig. E, being cited as illustrative. Reeve ('Conch. Icon.' X, pl. i, fig. 3, January, 1858) figured under Lamarck's name a Philippine Island shell and questioned the identity of the Rumphian species. The Australian shell is easily distinguished from the Philippine one by its dorsal side being nearly parallel with the ventral one, and its posterior extremity scarcely projecting beyond the umbones. It is more like the Rumphian figure, but is also more straight dorsally, and not sinuate medially ventrally. The type, from Moreton Bay, measures 120 mm. by 44 mm.

Modiolus ostentus sp. nov. (Plate VI, fig. 18.)

This is the shell resembling *elongatus* Swainson, from which it differs at sight in its shape and proportions. The hinge line is very long, two-thirds the length of the shell, the posterior side short, the anterior side very little produced before the beaks, the ventral consequently being very long and nearly straight. Coloration pale bright brown, with two yellowish radial lines originating at the umbo and thence one to the middle of the posterior margin, the other towards the postero-ventral edge below the posterior swelling. The shell is rather evenly swollen ventrally and the posterior area is flattened.

The extreme length of the specimen figured from Keppel Bay is 80 mm., the height 34 mm., this being the same as the parallel hinge height, and depth 23 mm.

Modiolus pulvillus sp. nov. (Plate VI, fig. 22.)

This little shell, secured at Low Isles, is representative of a species which has been given three names in attempts to determine it.

The shell is small, rather regularly elongate, the posterior portion not much wider than the anterior, the rounded anterior a little produced, the ventral margin a little sinuate, the dorsal margin only a little elevated posteriorly and gradually rounded to meet the ventral margin. The shell is rather evenly swollen, the posterior area covered with a fine periostracum, which collects mud. The coloration is dark purplish brown outside and purple inside. The specimen figured measures 25 mm. in length, 13 mm. in height and 13 mm. in depth.

This may be the *Modiola lignea* recorded by Melvill and Standen from Torres Straits.

"*Amygdalum arborescens*."

Melville and Standen (p. 184) recorded *Modiola arborescens* Chemn. from Boydong Cays, Torres Straits, while Shirley proposed to add *Modiola senhausii* Reeve from Murray Island. Hedley had regarded specimens in the Australian Museum collection from Cardwell and Mapoon, Queensland as *Modiola japonica* Dunker, but Japanese examples so named are easily separable, and Australian shells are definitely narrower than Reeve's

figure of *senhausii* (' Conch. Icon.' X, pl. v, fig. 22, October, 1857) from Chusan. As anticipated, our shells are not much like *arborescens*, but it is impossible to suggest what the shells Melvill and Standen had under review may be.

Genus *Dentimodiolus* nov.

Type : *D. sculptus* sp. nov.

Shell elongated, arched, striate, the edges denticulate within; hinge line short, less than half the length of the shell; ligament set upon a shallow shelf, above which the margin is strongly numerously toothed; teeth as round knobs, not interlocking with opposite series. These pseudo-teeth continue all along the upper margin and around the beaks, but disappear ventrally. At the anterior end there are a few stronger, which may act as real teeth, but generally none of this series of nodules can be classed as real teeth, but may be regarded as an intermediate stage. The ribbing is very fine and such as ordinarily would not denticulate the margin, and in life is covered by the periostracum. The muscle scars are peculiar, and the interrelationship of these Mussels will be dealt with later.

Dentimodiolus sculptus sp. nov. (Plate VI, fig. 20.)

In Hedley's Queensland list appears " *Brachydontes curvatus* Dunker, 1857, *Mytilus* ". The species so determined is here named as above. Dunker's species was named (' Proc. Zool. Soc. (Lond.) ' 1856, p. 361, 8th May, 1857) from Luzon, Philippine Islands, and was figured by Reeve (' Conch. Icon.' X, pl. xi, sp. 53, January, 1858), and the illustration is not much like our shell. However, all argument is obviated by the fact that Dunker's name is invalid, being preoccupied by Kloeden (' Verst. Mark. Brandenburg ' 1834, p. 208, fig. 8 E, Sherborn). It is a mainland species, and the shell figured is from Cairns and measures 30 mm. in length, 12 mm. in height and 11·5 mm. in depth.

The shell is elongate, the dorsal side gently arched, the posterior end rounded, the ventral margin medially sinuate and the beaks a very little produced. Coloration dark brown. The whole surface is finely striate, but in some specimens there is a smooth medial area as in *Musculus*, and the anterior ribbing is subnodulose; the ribs are rounded, flattened, close together, and over a hundred can be counted on the postero-ventral sector; there may be about twenty on the anterior sector, where the *Musculus* roll may be seen, while the ribs on mid-sector are fine and close.

Genus *Botulopa* nov.

Type : *B. silicula infra* subsp. nov.

A boring shell very like *Modiolus* is widely distributed throughout the coral reefs of the Indo-Pacific area. It has sometimes been regarded as *Botula* Mörch, *e. g.* by Dall, who wrote : " Surface deeply concentrically sulcate, shell inflated, with conspicuously spiral umbones, the epidermis polished. This section (of *Modiolus*), if it were not for its peculiar muscular scars, might perhaps equally well be placed under *Lithophaga*, as has been done by Fischer. It is intermediate, conchologically, between the boring *Lithophagi* and the nestlers, as regards externals." This does not really describe the present group, as it conchologically is very like *Modiolus*, and nothing like *Lithophaga*, where Hedley, following Fischer, ranged it. It is a true borer, not a nestler.

Mörch introduced *Botula* (' Cat. Conch. Yoldi,' II, p. 55, 1st April, 1853) with only two species, *arenaria* Meusch. = *Modiola vagina* Lam. = *M. castaneus* Gray (Rumph, 46 E), and *fusca*, Gm. List. 359, 197 = *brunneus* Sldr. = *cinnamomea* Lam. var. = *favanni* Pot. and Mich. Apparently Chenu (' Man. Conch.' II, p. 156, fig. 775, 1859) was the first to use the name, which unfortunately he did in a sense quite different from that of Mörch, figuring *Botula splendida* Dunker. This species had only been described in 1857, but notwithstanding this, Stoliczka (' Mem. Geol. Surv. Ind., Pal. Ind.' III, pp. 370 (xxi, March/August 1871) and Kobelt (' Illustr. Conch. Buch.' p. 364, pl. 106, fig. 10, 1884), both cited *splendida* as type of *Botula* Mörch, 1853. Dall (' Trans. Wagner Free Inst. Sci.' III, pt. iv, p. 792, late 1898) and Ihering (' Proc. Malac. Soc. (Lond.) ' 1900, p. 88) altered this by recording *cinnamomea* Lam. as type, but again incorrectly, as this was not one of Mörch's species, his citation being of *cinnamomea* Lam. *var.*—a different thing. I here select *fusca* Gm. based on Lister 359, 197, as type of *Botula* Mörch, and this name will not trouble Australian malacologists, as Lister's figure does not apply to any shell like our species. Dall used the name *Modiolus* (*Botula*) *cinnamomeus* Lamarck, for his Florida fossils, writing, " I am not able to determine whether the East Indian shell usually called *M. fuscus* Gmelin is the same or distinct specifically. The distribution of boring species is often very wide. It is certain, however, that Chemnitz's specimens, on which Lamarck founded the species, were West Indian ".

As noted above, Gmelin's name was given to Lister's figure alone, with no locality cited, and there is no reason to regard it as East Indian : it is figured on a plate marked " Jamaic.", so that it would be West Indian, and the name for the West Indian species would be *fuscus*. Further, Lamarck introduced *Modiola cinnamomea* for shells in the Paris Museum, and his own collection, from the seas of the Isle of France, and merely cited Chemnitz's figure as illustration thereof. As a " var. b " he gave Lister's figure, and noted, " La variété [b] a été trouvée dans l'intérieur de polypiers pierreux ".

Thus, Lamarck's *cinnamomeus* would be correctly available for the Mauritius species, but Link (' Beschr. Nat. Samml. Univ. Rostock,' III, p. 147, 1807) had previously introduced *Modiolus cinnamomeus*, based on Chemnitz's species, and thus invalid for the Eastern species ; apparently Schreibers (' Vers. Conch. II, p. 293, 1793) had even anticipâted Link.

There is, however, a Lamarckian name for the Australian form, *silicula*, and this is here used. As our shell does not agree at all with the generic description applied by Dall for *Botula*, and the habits of our shell are also known correctly, the above generic name is introduced to avoid further confusion. Our shell has not a " deeply concentrically sulcate surface ", being smooth with rather well-marked growth stages only ; the umbones are decidedly *not* conspicuously spiral, exceeding very little if at all the normality of *Modiolus* or *Lithophaga* s.l. The muscle scars are not very peculiar, nor would any field worker place it under *Lithophaga*, nor is it intermediate in any sense between the " boring *Lithophagi* " and the nestlers, as it is a true boring *Modiolus* only.

Botulopa silicula infra subsp. nov. (Plate VI, fig. 26.)

1819. *Modiola silicula* Lamarck, Hist. Anim. s. Vert. VI, pt. 1, p. 115 (31st July) : Seas of New Holland = Sharks' Bay, W.A.

This species is thus described : " M. testâ oblongâ, cylindraceâ, rectâ, unifariam striatâ ; extremitatibus obtusis ; anticâ retusâ. Habite les mers de la Nouvelle Hollande.

Mus. no. Elle est moyenne entre la précédente (*Modiola cinnamomea*) et celle qui suit (*M. plicata*). Coquille blanche ; épiderme marron très-brun. Longueur, 25 millimetres. Elle n'a que les stries d'accroissement."

The preceding (*M. cinnamomea*) was localized as "Habite les mers de l'Isle de France", and "'Chemn. Conch.' VIII, t. 82, fig. 731, 'Encyclop.' pl. 221, fig. 4" were cited as illustrations. Many years later, Tate described *Lithodomus projectans* ('Trans. Roy. Soc. South Austr.' XV, p. 130, pl. i, fig. 1, December, 1892) from Port Darwin, Northern Territory, as being like *cinnamomeus*, but distinguished by absence of decussated sculpture. The Queensland species appears to differ slightly in form, and may be called *Botulopa silicula infra* subsp. nov. Otter noted that it was "commonest on the reef flat in dead coral rock which is usually in an advanced stage of decomposition". The type is a Low Isles shell measuring 26·5 mm. in length, 12 mm. in breadth, and 12 mm. in depth.

Trichomusculus barbatus Reeve, 1858.

Melvill and Standen (p. 184) admitted *Modiola* (*Adula*) *lanigera* Dkr. from Station II, Warrior Island. The name *Lithodomus laniger* was published by Reeve ('Conch. Icon.' X, *Lithodomus*, pl. v, for fig. 30, January, 1858, from Australia) as of Dunker MS. in Mus. Cuming, and has always since been accepted as a synonym of *Lithodomus barbatus* Reeve, published at the same time for fig. 27, from Sydney (in mud at the depth of 6 fathoms). This is a well-known Sydney species, which occurs also in South Queensland, but there is nothing like it in this Museum from Torres Straits. It does not belong to the *Modiola* series even.

Genus *Lithophaga*.

1798. *Lithophaga* Bolten, Mus. Bolten, II, p. 156, September.
Haplotype : *L. mytuloides* = *M. lithophagus* Gmelin.
1811. *Lithophagus* Megerle, Ges. Nat. Freunde Berl. Mag. VI (1), p. 69.
1816. *Lithodomus* Cuvier, Règne Anim. II, p. 461, "1817" = December, 1816.
Logotype : Herrmannsen, Index Mal. I, p. 611, 1847. *M. lithophagus* Lima.
1820. *Lithotornus* Schweigger, Handb. Naturg. p. 712 (pref. 1st May). Error only for *Lithodomus* Cuvier, corrected on p. 776.
1821. *Lithoglyphus* Sturm, Deutsch. Fauna (VI Wurm), (5), p. 57, as of Megerle : New name for *Lithophagus* Megerle, *fide* Bucquoy, D. et D., Moll. Mar. Roussillon, II, p. 159, April, 1890.
1886. *Myoforceps* Fischer, Manuel de Conch. X, p. 969, 30th April.
Haplotype : *Modiola caudigera* Lamarck.
1898. *Diberus* Dall, Trans. Wagner Free Inst. III (4), p. 799 (April = November).
Orthotype : Lithodomus *plumulus* Hanley.
1916. *Labis* Dall, Check List Rec. Biv. Moll. North-West America, p. 19.
Haplotype : Modiola *attenuata* Deshayes.
[1857. *Leiosolenus* Carpenter, Cat. Mazatlan Shells Brit. Mus. p. 130.
Haplotype : Liiosolenus *spatiosus* Carpenter.]

Dall ('Trans. Wagner Free Inst. Science,' III, pt. 4, pp. 798–799, 1898) separated the Date Mussels into five sections : *Lithophaga* s.s., *Adula* H. and A. Adams, 1857, *Leiosolenus* Carpenter, 1856, *Myoforceps* Fisher, 1886, and *Diberus* Dall, 1898. All these names were given to Northern forms, the type of *Lithophaga* being the Mediterranean species without calcareous deposition and with perpendicular striae anteriorly. The well-known "*teres*" of the Pacific Ocean agrees in general in facies, but the animals may differ very appreciably when comparisons are made.

Adula H. and A. Adams does not appear to have any close relationship with the Date Mussels, and is not given any further consideration here. Dall writes of *Leiosolenus* Carpenter as " Shell like *Lithophaga,* but building a doubly tubular spout to the aperture of its burrow, and therefore probably furnished with elongated tubular siphons ". Such a description definitely removes this group from among the Date Mussels as studied in Australian waters. *Myoforceps* had been provided by Fisher 1886, for a West Indian form, which covered the tips of the valves with a smooth chalky incrustation, which extends with a twist forming a crossed projection.

Then *Diberus* was proposed for the American species with a chalk deposition meeting regularly beyond the tip of the valves, though the chalk is curiously irregularly laid down. Later Dall added *Labis* for a South American species with a very elongated smooth chalky deposition, whose tips meet closely. None of these chalk-bearing forms show the anterior perpendicular striation of the non-encrusted species. The magnificent collection made by Mr. Guy W. Otter at Low Isles indicates the distinction of the Indo-Pacific series, and while "*teres*" as above noted resembles the typical Mediterranean *Lithophaga,* the remainder of our species disagree with the sections indicated by Dall. There is a series of species with very little or no incrustation, in any case not exceeding the valves, and being non-striate perpendicularly anteriorly. These may form a section *Myapalmula,* the species *L. dichroa* being named as type. The chalky-tipped series is also divisible, but none shows the regular feathering of *Diberus,* nor the attenuation of *Labis,* nor the twisting of *Myoforceps.* There is a species with smooth incrustation anteriorly, but it is truncated, and meets tightly, and a section *Doliolabis* is provided, the type being the Australian *L. laevigatus instigans.* The common chalky-tipped species with the chalk irregularly and roughly laid down and extending beyond the tips of the valves is something like *Diberus,* and the sectional name may be based on that name, *Exodiberus,* but this does not imply phylogenetic affinity, the type being the shell called *L. calcifer,* but there may be many species in this section.

The species *L. divaricalx* is so unlike in shell features, though similarly incrusted, that a sectional name must be introduced for it. As a matter of fact it simulates *Diberus* more closely than the previous section. The name *Salebrolabis* is provided for this, the incrustation with the median elevated crinkled section being diagnostic.

The Australian members may be characterized thus :

Genus *Lithophaga.*—Elongate bivalve shells with the umbones subterminal, the posterior edge scarcely exceeding them, the prolonged anterior portion being more or less divided diagonally, the dorsal section smooth, sometimes heavily incrusted with chalk, the incrustation projecting, but never twisting ; the ventral section rarely perpendicularly striate, more commonly smooth, with a slight chalky deposit.

As sections may be nominated :

Lithophaga sensu stricto.—Non-incrusted species with the ventral anterior section perpendicularly striate.

Myapalmula.—Smooth shells lacking the striation and with very little or no chalky deposition, definitely no extended chalky tip.

Doliolabis.—Smooth shells with smooth chalky covering extending beyond the tips of the valves.

Exodiberus.—Smooth shells with rough chalky covering extending beyond the tips but not in regular feathery formation ; shell fairly regularly elongate.

Salebrolabis.—Smooth shells with very roughened, raised chalky incrustation, just extending beyond the tips of the valves and meeting closely; shell rather broad, with elevated dorsal angle.

It will be best to deal with the species living together on Low Isles as a whole, and then indicate the lessons to be learned. Before Mr. Guy W. Otter began his investigations into the molluscs boring coral rock, practically nothing was known about the species or their variation, and names were being used quite indiscriminately. Otter was very enthusiastic and made large collections, and it was found that the species varied very little, and were easily distinguished in the field. The Modiolid forms are only discriminated here, but it may be explained that in addition there were species of *Rocellaria* (= *Gastrochaena*), *Petricola* and *Coralliophaga*, also engaged in boring. The apertures of these were noted as being different, indicating the inhabitant of the burrow by their form.

Seven species are easily distinguished, and each of these shows a distinctive method of encrustation. First, the well-known "*teres*" form stands alone in its entire absence of chalky covering, the anterior-ventral section being perpendicularly striate, the posterior-dorsal section clean and corrugated with deep growth-lines only. *Otter's No.* 1.

Second, "*nasuta*-like" is bicolor, a feature separating it from all the others, the anterior-ventral section being pale brown covered in the adult with a light chalky film; the posterior-dorsal section is blackish-brown, the dorsal edge paler, with only a poor chalky deposition, the growth-lines showing. *Otter's No.* 4.

Third, a smaller shell like the preceding, pale unicolor green with a slight irregular deposition of chalk; this, like the former, is unsculptured, save for growth lines, which are not as marked as in "*teres*". *Otter's Nos.* 6 *and* 7.

Fourth, the largest species, "*obesa*", pale unicolor brown, the anterior-ventral section with a very light chalky covering, the posterior-dorsal section somewhat irregularly showing chalky deposition, the chalk being thickened towards the posterior end; no heavy growth-lines. *Otter's No.* 3.

Then come three heavily chalk-tipped forms; the first of these, the most common, has the anterior-ventral section slightly chalk-covered, the posterior-dorsal covered with a feathery chalk formation, which extends beyond the edges of the shell posteriorly gaping, but not twisted like *Myoforceps*. *Otter's Nos.* 2 *and* 5.

The second is practically smooth and not chalky, save the tip, which has a solid, not feathery, deposition meeting closely, though extending a little beyond the shell. *Otter's No.* 2.

The third, an uncommon species, has a complete chalky covering, the anterior-ventral section slightly but fairly completely, the dorsal ridge, which is angulately elevated, also roughly covered, but between a strong series of chalky divaricating irregular ridges tightly closing at the tip. *Otter's Nos.* 2 *and* 5.

It was found that when two or three species were associated in one coral block, they were occupying different stations. Moreover, forms were definitely restricted to certain species of coral, and probably many more will later be separated. This collection, and research by Otter, have been inestimable in the elucidation of the boring mollusc problem. On the way down from Low Isles, Otter collected some specimens at Cape Cleveland, near Townsville, all *teres* save one, which is a fine large shell closely related to the one I am calling *divaricalx*, but with the dorsal angle less elevated and the chalky deposition of much less extent and may be the mainland representative.

At Goat Island, Moreton Bay, Queensland, a number of Date Mussels was picked out of coral living below low water. The coral was brain-coral and no less than six species of molluscs were found boring therein, four species being Date Mussels. At the base one specimen of the " *obesa* " form was found and one specimen of the " *teres* " style. The former was similar to that found at Low Isles, but the *teres* shell was of the short and broad form. There were many of a plain pale-coloured shell, larger than the small one from Low Isles, but much less than the bicolor one. Then a few with a corrugated chalk tip were found, and these were thinner and more pointed anteriorly and also more projecting posteriorly. At the Capricorn Group, on North-West Islet, four species were also found boring into *Porites*, and possibly many more would have been found had the tides been better. One with a corrugated chalk tip was smaller and differently shaped from the Low Isles one, and another with a solid chalk tip also different in shape from the Low Isles " *laevigata* " ; a curious small barrel-shaped shell with a small chalky tip was unlike anything previously found, while a small plain pale one was comparable with the smallest Low Isles species, but was definitely broader.

Mr. Melbourne Ward made a collection of these Mussels at Lindeman Island, and then Mr. G. P. Whitley and myself have since collected these molluscs in that locality. The predominating species was " *teres* ", the apparent shorter and broader form, but specimens representing three of the Low Isles species were also found, with another we had not found at that locality, and which was already in this Museum from Moreton Bay under the name *mucronata* Philippi, which it recalls ; it is the barrel-shaped species with chalky tip referred to in the North-West Islet collection.

As regards the nomination to be used there was at first great difficulty on account of the varied attempts at identification already in use by other workers.

Schmeltz had recorded *teres* Philippi from Cape York, and then added *corrugata* Philippi from Port Denison. Smith reported *teres* Philippi from Port Denison, and added *malaccanus* Reeve from Cape York. Then, Melvill and Standen concluded that four species lived in Torres Straits, and selected for these *canalifera* Hanley, *gracilis* Philippi, *hanleyana* Reeve and *teres* Philippi. Hedley collected some shells at Mast Head Islet, Capricorn Group, and brought in *laevigata* Quoy and Gaimard in place of *malaccana* (Reeve) Smith, and added *stramineus* Dunker and *cinnamomea* Lamarck. Thus, the Queensland list read : *canalifera* Hanley, *cinnamomea* Lamarck, *corrugata* Philippi, *gracilis* Philippi, *hanleyana* Reeve, *laevigata* Quoy and Gaimard, *straminea* Dunker and *teres* Philippi.

Lynge (p. 136) considered *gracilis* Philippi and *teres* Philippi as identical, preferring the former name, but *teres* had priority, and *gracilis* was invalid. Lynge then commented (p. 137) under the heading *malaccana* Reeve : " The present species, like all boring molluscs, is subject to great variation in regard to form ; I have put *L. subula* Reeve and Dunker's *L. cavernosa* and *reticulata* as synonymous forms, and several more could no doubt be added."

Otter's collections have considerably altered that view, as great constancy was found, the individual variation being negligible.

The names that have been cited in Australian connection are here arranged chronologically for reference :

1835. *Lithodomus lævigatus* Quoy and Gaimard, Voy. " Astrol.," Zool. III, p. 464, pl. lxxviii, figs. 17, 18 : Port Dorey, New Guinea.

1844. *Lithodomus canaliferus* Hanley, Proc. Zool. Soc. (Lond.) 1844, p. 16, July: I. Zebu, Philippine Islands.
Figd. Reeve, Conch. Icon. X, pl. iv, sp. 25, October, 1857.
1846. *Modiola corrugata* Philippi, Abbild. Conch. II, p. 147, pl. i, fig. 1, October: No locality; later, *idem. ibid.*, IV, p. 21: West Indies.
1846. *Modiola teres* Philippi, Abbild. Conch. II, p. 148, pl. i, fig. 3, October: Oceanus Pacificus.
1846. *Modiola nasuta* Philippi, Abbild. Conch. II, p. 149, pl. i, fig, 2. October: Oceanus Pacificus.
1846. *Modiola mucronata* Philippi, Abbild. Conch. II, p. 150, pl. i, fig. 8, October: Java.
1847. *Modiola (Lithophagus) malayana* Philippi, Zeitschr. für Mal. 1847, p. 117, August: China Sea.
Figd. Abbild. Conch. III, p. 21, pl. ii, fig. 6, September, 1847.
1847. *Modiola (Lithophagus) gracilis* Philippi, Zeitsch. für Mal. 1847, p. 117, August: China.
Figd. Abbild. Conch. III, p. 19, pl. ii, fig. 1, September, 1847.
1847. *Modiola (Lithophagus) obesa* Philippi, Zeitschr. für Mal. 1847, p. 118, August: China ?.
Figd. Abbild. Conch. IV, p. 19, pl. ii, fig. 2, September, 1847.
1857. *Lithodomus cumingianus* Reeve, Conch. Icon. X, pl. ii, sp. 8, October *ex* Dunker MS.: North Australia and Mazatlan.
1857. *Lithodomus stramineus* Reeve, Conch. Icon. X, pl. ii, sp. 11, October *ex* Dunker MS.: West Indies.
1857. *Lithodomus hanleyanus* Reeve, Conch. Icon. X, pl. iv, sp. 19, October *ex* Dunker MS.: Suez.
1858. *Lithodomus malaccanus* Reeve, Conch. Icon. X, pl. iv, sp. 20, October: Malacca.
1882. *Lithophaga ventrosa* Clessin, Conch. Cab. (Mart. and Chemn.) ed. Kuster, VIII, Abth. 3*a*, p. 4, pl. i, figs. 3, 4, *ex* Dunker MS.: Lord Hood's Island.
1882. *Lithophaga nasuta* Clessin, Conch. Cab. (Mart. and Chemn.) ed. Kuster, VIII, Abth, 3*a*, p. 5, pl. i, figs. 5, 6 (Philippine Islands); pl. ii, figs. 7, 8, *ex* Dunker MS.: West Indies.
var. *minor* nom. nud.: North Australia.

Lithophaga divaricalx sp. nov. (Plate VI, fig. 23.)

This fine species was rarely found among the dead coral boulders at extreme low water.

Shell of medium size, with elevated dorsal angulation and strong calcification posteriorly, a hard median division showing elevated divaricating ridges, a dorsal band of fine pustulose ridges parallel to the dorsal angle and the remainder of the shell with a fine chalky encrustation, the shell being red brown where this is scratched off. The anterior end is rounded, scarcely exceeding the umbones, and the dorsal angulation is posterior to the middle and rather steeply descends to the extremity; the ventral margin is faintly curved. The specimen figured measures 44 mm. in length, 18 mm. at greatest height, and 15 mm. in depth.

The chalky extremities meet tightly, exceeding the shell very little.

Lithophaga calcifer sp. nov. (Plate VI, fig. 28.)

This chalk-tipped species was found in living *Favia*, *Goniastrea* and *Pocillopora*, as well as in dead coral boulders. The differences observed have not been sufficient for differentiation, but it is possible that the different corals are the habitat of distinct forms of chalky-tipped Date Mussels.

Shell small, very little dorsal elevation, strong chalky crust exceeding the end of the shell appreciably and not attingent. The chalky tip is solid, but shows wrinkles and hollows, but not separable into ridges, but this pustulose appearance covers the whole dorsal sector, the ventral sector being also covered with a thin, flattened, smooth chalky film, the shell underneath being a rich brown. The anterior end is rounded, scarcely exceeding the umbones, and the dorsal line is only weakly angled, the angle very little behind the middle. The ventral margin is slightly curved.

The figured specimen measures 42 mm. to the end of the chalk, 13 mm. at greatest height, and 10 mm. in depth.

Lithophaga simplex sp. nov. (Plate VI, fig. 25.)

A small, pale, unicolor non-chalky form only found in living *Porites* and living *Symphillia* at Low Isles.

Shell small, with marked dorsal angulation, but without any massed chalky incrustation. Coloration pale greenish brown. There is a very slight chalky covering, but it is not continuous, only showing patchily and being very thin, so that the colour of the shell predominates. The anterior extremity is a little produced and rounded, the ventral margin straight and the dorsal angle elevated, but anterior to the middle and sloping gently posteriorly.

The shell figured measures 28 mm. in length (there is no chalky tip), 10 mm. in height and 9 mm. in depth.

Lithophaga dichroa sp. nov. (Plate VI, fig. 31.)

Otter wrote : " This is much the commonest lamellibranch borer on Low Isles both in dead coral boulders, and in the beach limestone." It has been confused with *laevigatus*. but is easily separated by means of its small size, shape and bicoloration, all the other species being uniformly coloured. It seems most like *Modiola nasuta* Philippi, as figured in the ' Conch. Cab.' (Mart. and Chemn.), ed. Kuster, VIII, Abth. 3*a*, pl. i, figs. 5–6, 1882, but not so much like Philippi's original figure (' Abbild. Beschr.' II, pl. 149, pl. i, fig. 2, October, 1846 : Pacific Ocean). The last-named was only localized as " Pacific Ocean ", while the ' Conch. Cab.' figures cited were drawn from a Philippine Island shell. In the ' Conch. Cab.', other figures are given, pl. ii, figs. 7, 8, under the same name, but which belong to an entirely different species. Reeve (' Conch. Icon.' X, pl. ii, sp. and fig. 10, October, 1857) figured two entirely different species from the Island of St. Thomas, West Indies, under Philippi's name. Clessin, in the ' Conch. Cab.' (p. 5), wrote " var. *minor*, *ex* Australia septentrionali ", and " und eine kleinere Varietat von Australien ". This can only be discarded as an unrecognizable *nomen nudum*.

The present species is of medium size, with the division into two sectors by means of a line drawn from the umbones to the posterior ventral extremity marked by different coloration. There is a thin calcification covering the ventral sector, so that it often exposes the pale red-brown coloration of this part ; the dorsal sector is dark purplish brown, with the dorsal margin red brown, and there is also a thin calcareous covering which, however, does not conceal the coloration save towards the extremities, but it does not form a projecting tip. The anterior end does not exceed the umbones, but it is rounded with the ventral margin almost straight. The dorsal margin is only very bluntly angled, the angle being practically median.

The shell figured measures 59 mm. in length, 19 mm. in height, and 15 mm. in depth ; a long series, constant in form, calcification and coloration vary in size from 10 mm. in length, by 3·5 mm. in height and 2·5 mm. in depth, to 79 mm. in length, 22·5 mm. in height and 18 mm. in depth.

Lithophaga laevigata instigans subsp. nov. (Plate VI, fig. 27.)

1835. *Lithodomus laevigatus* Quoy and Gaimard, Voy. " Astrolabe ", Zool. III, p. 464, pl. lxxviii, figs. 17, 18 (after March) : Port Dorey, New Guinea.

Although many species have been called by Quoy and Gaimard's name, their shell has a characteristic shape and is well distinguished. The Low Isles shells so determined were found in dead coral boulders near low-water mark. The shell is of small to medium size and has only a slight dorsal elevation a little posterior to the middle, the general form being stouter than any of the others, the anterior portion having the ventral and dorsal margins almost parallel. The anterior extremity is almost truncate, scarcely exceeding the umbones. The posterior extremity shows a truncate solid chalky tip, which meets tightly, a little angulate medially. This chalky incrustation is solid and smooth, but there is very little chalky covering elsewhere on the dorsal sector, while the ventral sector is very finely smoothly incrusted. The coloration is pale brown, and is generally conspicuous.

The shell figured measures 48·5 mm. to the end of the chalky tip, 14 mm. in greatest height and 13 mm. in depth.

Lithophaga teres annectans subsp. nov. (Plate VI, fig. 29.)

1846. *Modiola teres* Philippi, Abbild. Beschr. Conch. II, p. 148, pl. i, fig. 3, October : Oceanus Pacificus.

Philippi's shell measured 23 mm. in length by 6 mm. in height and 5¼ mm. in depth, and has been commonly recognized on account of the dark coloration, lack of chalky incrustation and ventral sector perpendicularly striate.

A fine series was collected at Low Isles and a graded number was measured, giving length, height and depth as follows : 19·6 by 6 by 4·5 mm., 24 by 6·5 by 5 mm., 31 by 9 by 7 mm., 39 by 11 by 9 mm., 54 by 15 by 12 mm., 63 by 15 by 15 mm., and 66 by 18 by 15 mm.—the figured specimen.

The mainland shells superficially appear rather shorter and broader, but measurements fail to show an appreciable variation, as follows : from Port Curtis, 38·5 by 12 by 11 mm., 43 by 13 by 11 mm., 42 by 14 by 13 mm., 52 by 18 by 15 mm., 64 by 21 by 19 mm., 63·5 by 17 by 15 mm., and from Rat Island, Port Curtis, 41 by 12 by 10 mm., 48 by 17·5 by 16 mm., 50 by 14 by 11 mm., 64 by 17 by 14 mm., 74 by 22 by 19 mm., and 89 by 24 by 21 mm. It is possible that there may be many subspecies, as broad shells have been examined from New Caledonia and the Paumotus, but the Vanikoro shells are slender.

Lithophaga obesa suspecta subsp. nov. (Plate VI, fig. 30.)

1847. *Modiola obesa* Philippi, Abbild. Beschr. Conch. III, p. 19, pl. ii, fig. 2, September : China ?

This, the largest of the Queensland Date Mussels, lives at the base of the niggerheads, generally at dead low water mark and below.

The shell is somewhat differently shaped than any of the others, being attenuate anteriorly and broadened posteriorly without any angulation. The coloration is pale brown and the dorsal sector is more or less covered with a fine chalky crust, which is very thin, but becomes thicker towards the posterior extremity, where it becomes slightly pustulose, but does not extend beyond the shell ; the ventral sector is nearly covered with

a very fine smooth crust. The anterior extremity is not produced and the ventral margin is almost straight; the dorsal margin slopes upward gently from the umbo to about half the length of the shell and then proceeds in a gentle curve to the posterior extremity, which is rounded.

The figured specimen measures 84 mm. in length, 29 mm. in height, and 21 mm. in depth, a valve reaching 96 mm. in length by 34 mm. in height, while a small shell measures 16 mm. in length, 8 mm. in height and 5·5 mm. in depth.

Genus *Musculus*.

1798. *Musculus* Bolten, Mus. Bolten, II, p. 156, September.
Logotype: Iredale, Journ. Conch. XIV, p. 342, *Musculus discors* Bolten = *Mytilus discors* Linné.
1838. *Modiolaria* Beck, Comm. Sci. Island (Robert) Atlas Moll. pl. xvii.
Haplotype: *Mytilus discors* Linné.
1840. *Lanistes* Swainson, Treat. Malac. p. 385, May (*ex* Humphrey).
Haplotype: *Mytilus discors* Linné.
1840. *Modiolarca* Gray, Synops. Contents B.M. 42nd ed., p. 151, n.n. post 16th October.
1843. *Modiolarca* Gray, Travels in N.Z. (Dieffenbach), II, p. 259, January.
Haplotype: *Mytilus impactus* Hermann.
1847. *Lanistina* Gray, Proc. Zool. Soc. (Lond.) 1847, p. 199, November.
Orthotype: *Mytilus discors* Linné.

These shells are easily recognized by their radiating sculpture with the smooth intervening medial space, and while they appear to be closely related to *Modiolus*, the variation in the animals appears to be more notable than in the shells.

Musculus cumingianus Reeve, 1857.

1857. *Modiola cumingiana* Reeve, Conch. Icon. X, pl. ix, fig. 50, December (*ex* Dunker MS.): Moreton Bay, Queensland.

This specific name has been used for specimens from any locality on the east coast of Australia, and has been confused with another group, which has borne the name *cuneatus* Gould, given to a Cape of Good Hope species. Smith at one time regarded *cuneatus* as not even separable from the British *marmorata*, and figured a specimen apparently from Port Jackson, in the 'Challenger Reports' (XIII, p. 278, pl. xvi, figs. 7, 7*a*, 1885). In the same place Smith gave the distribution of *cumingiana* as Spencer's Gulf, South Australia, and Swan River, West Australia, as well as Moreton Bay and Sydney, and even added a "pretty pink variety" from the Red Sea.

Musculus mirandus Smith, 1884.

1884. *Modiolaria miranda* Smith, Rep. Zool. Coll. "Alert", p. 108, pl. vii, fig. N, 12th July: Dundas Straits, Melville Island, North Australia.

This little species occurred in the dredgings at Low Isles.

Musculus perstriatus Hedley, 1906.

1906. *Modiolaria perstriata* Hedley, Proc. Linn. Soc. N.S.W. XXXI, p. 472, pl. xxxvi, fig. 9, 10, Nov. 19.: Mast Head I., Capricorn Group, Queensland.

Many specimens were found in the Low Isles dredgings, and these may later be separated from the typical shells

Genus *Tibialectus* nov.

Type: *T. otteri*, sp. nov.

This curious group of Ark-like *Musculus*, found boring in coral, has not previously been distinguished by name, a very closely-related species being described as *Lithodomus coarctata* by Reeve ('Conch. Icon.' X, *Lithodomus*, pl. iii, sp. and fig. 14, October, 1857) from the Gallapagos Islands, the specific name being accredited to Dunker, who had placed it under the generic name *Volsella*, the name being MS. only. The hinge line is short, a sharp angle forming the produced posterior area, which is separated by a very strong angle, the area being concave ; the ventral side is convex with a medial angulate sinuation, the anterior abruptly rounded. The sculpture of the *Musculus* style, the anterior area being small, radially sculptured, the median smooth, the posterior radially almost vertically striate, the posterior area being almost transversely coarsely ribbed.

Tibialectus otteri sp. nov. (Plate VI, fig. 24.)

Shell almost shoe-shaped, apparently beginning life as a slightly angled *Musculus*, but developing eccentrically. The posterior angle is very marked, the posterior area being concave, the ribbing on this area consisting of between forty and fifty rounded separated ribs, a dorsal angle appearing at about the anterior third. The ribbing on the posterior section of the antero-ventral area is very fine and with narrow interstices, apparently all smooth; anterior area is very small, with similar ribbing, a little crenulate by growth lines, which also occur on the median sector where there are no radials. The coloration is pale green, and the length of the type, collected at Low Isles, is 22·5 mm., the height 11 mm. and the depth 10 mm.

Under the generic name *Modiolaria* Hedley included in the Queensland list six species: *barbata* Reeve, *cumingiana* Reeve, *cuneata* Gould, *miranda* Smith, *perstriata* Smith and *splendida* Dunker. The first-named is now the type of *Trichomusculus*, and the last named was associated with it. Neither of these occurs on the Reef as far as is yet known, being purely coastal species, probably only living in Southern Queensland, ranging southwards to Tasmania. The Sydney shell figured by Reeve as Dunker's *splendida* and refigured by Hedley ('Proc. Linn. Soc. N.S.W.' 1901, p. 707, 20th May, 1902) is certainly not Dunker's species, the size and form disagreeing obviously.

Genus *Septifer*.

1848. *Septifer* Recluz, Rev. Zool. (Cuv.) p. 275, October.
Orthotype : *Mytilus bilocularis* Linné.
1853. *Septiger* Mörch, Cat. Conch. Yoldi, II, p. 52, April. Error only.

This well-marked generic form is variable as regards form, but the variation appears to be individual and therefore the general diagnosis reads : Shell elongate, umbones terminal, dorsal side more or less elevated posteriorly, the ventral side straight or sinuate. Coloration variable, blue, green and reddish brown. External sculpture radiating closely-packed flattened ridges. The internal edge crenulate, hinge short, placed on an internal ledge ; umbonally with strong teeth, a muscle-shelf in front.

Septifer bilocularis Linné, 1758.

1758. *Mytilus bilocularis* Linné, Syst. Nat. 10th ed., p. 705, 1st January: O. Indico.

This form was fairly common under coral blocks and in crevices, and was very variable in form. Consequently, although Odhner has illustrated Linné's type, and suggested separation of the Australian shells, nothing of constancy has been recognized as diagnostic for a separative character.

Septifer excisa Wiegmann, 1837.

1837. *Tichogonia excisa* Wiegmann, Arch. für Naturg. III, pt. 1, p. 49: Indian Ocean.

Many small shells were found, and these had been regarded as representing Wiegmann's species. There appears to be even more variability in connection with these small species than with the larger one, or else more than one species is being confused. The material available is insufficient to determine so the shells are here allowed to remain under the above name with doubt.

To complete Queensland Mytiloid forms two other species may be mentioned: *Myrina coppingeri* Smith ('Rep. Chall. Zool.' XIII, p. 281, pl. xvi, figs. 9, 9*b*, 1885) was given to a small shell dredged at Station 184 in 1400 fathoms east of Cape York. Smith pointed out that this species differed from the only known (at that time) species of the genus *Myrina* in having the hinge line striated across on each side of the ligament. As *Myrina* is invalid, the new generic name *Miridas* is proposed for *Myrina coppingeri* Smith.

A very pleasing little shell was named *Congeria lunata* by Hedley ('Proc. Linn. Soc. N.S.W.' XXVII, p. 8, pl. i, figs. 1–4, 22nd August, 1902) on account of its very peculiar shape. It is a marine species ranging along the Queensland coast, and has been found living on the globose Arks at Keppel Bay and Seaforth, and is obviously a *Modiola* derivative, but nothing whatever to do with *Congeria*, which is made a fossil subgenus of *Dreissena*, a fresh-water mussel of Europe.

The generic name *Ciboticola* is introduced, the strong curvature of the shell, the concave ventral area, the very short hinge line, the terminal umbones and the small interior umbonal shelf being cumulatively important.

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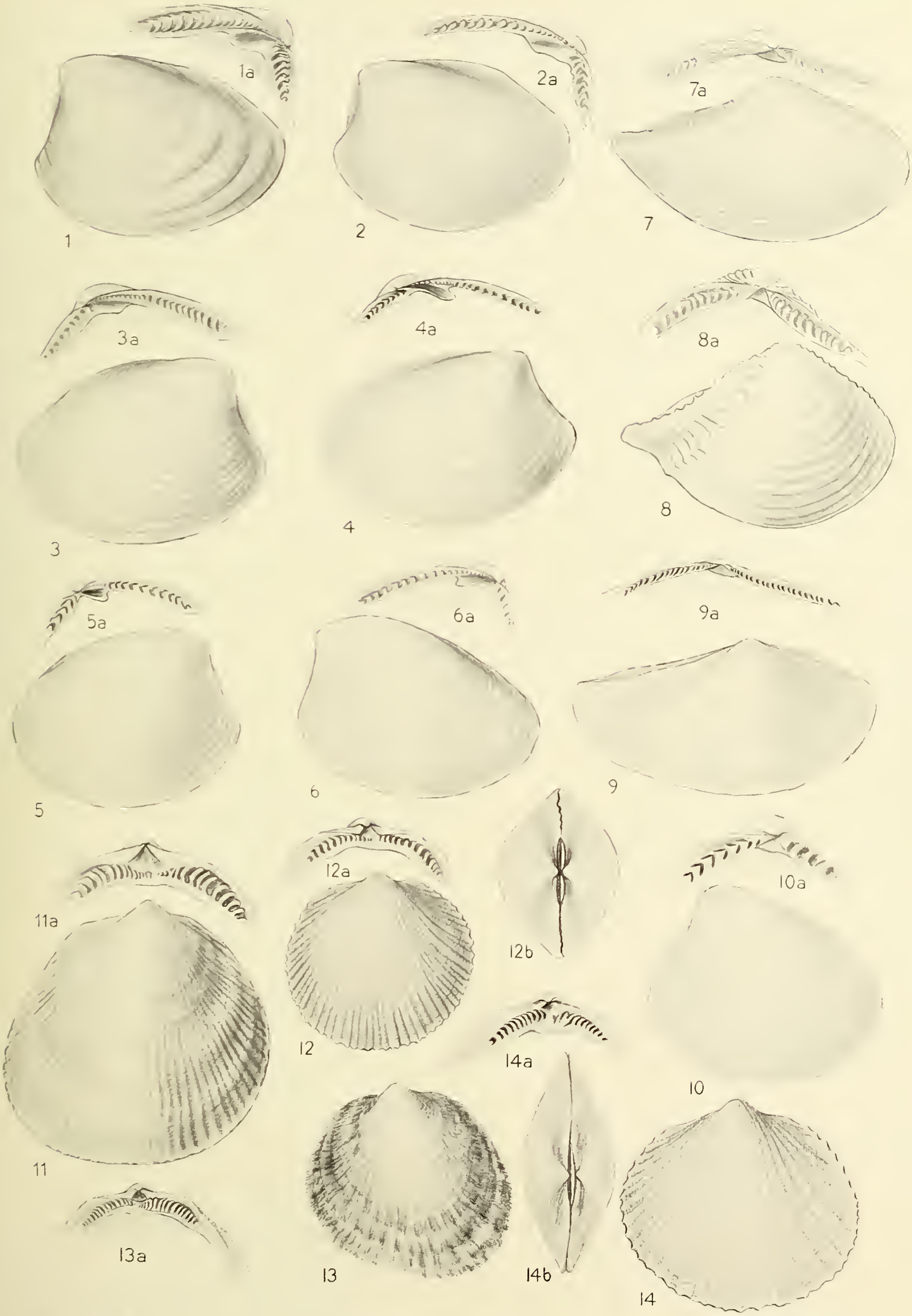
DESCRIPTION OF PLATE I.

Figs. 1, 1*a*.—*Ennucula superba* Hedley.
Figs. 2, 2*a*.—*Ennucula compar* Iredale.
Figs. 3, 3*a*.—*Ennucula definita* Iredale.
Figs. 4, 4*a*.—*Ennucula loringi* A. Adams and Angas.
Figs. 5, 5*a*.—*Ennucula privigna* Iredale.
Figs. 6, 6*a*.—*Ennucula orekta* Iredale.
Figs. 7, 7*a*.—*Scaeoleda novaeguineensis satagea* Iredale.
Figs. 8, 8*a*.—*Zygonoleda corbuloides minutalis* Iredale.
Figs. 9, 9*a*.—*Tepidoleda lata orion* Iredale.
Figs. 10, 10*a*.—*Pronucula saltator* Iredale.
Figs. 11, 11*a*.—*Oblimopa macgillivrayi actaviva* Iredale.
Figs. 12, 12*a*, 12*b*.—*Circlimopa woodwardi mutanda* Iredale.
Figs. 13, 13*a*.—*Circlimopa woodwardi mella* Iredale.
Figs. 14, 14*a*, 14*b*.—*Circlimopa woodwardi piabilis* Iredale.



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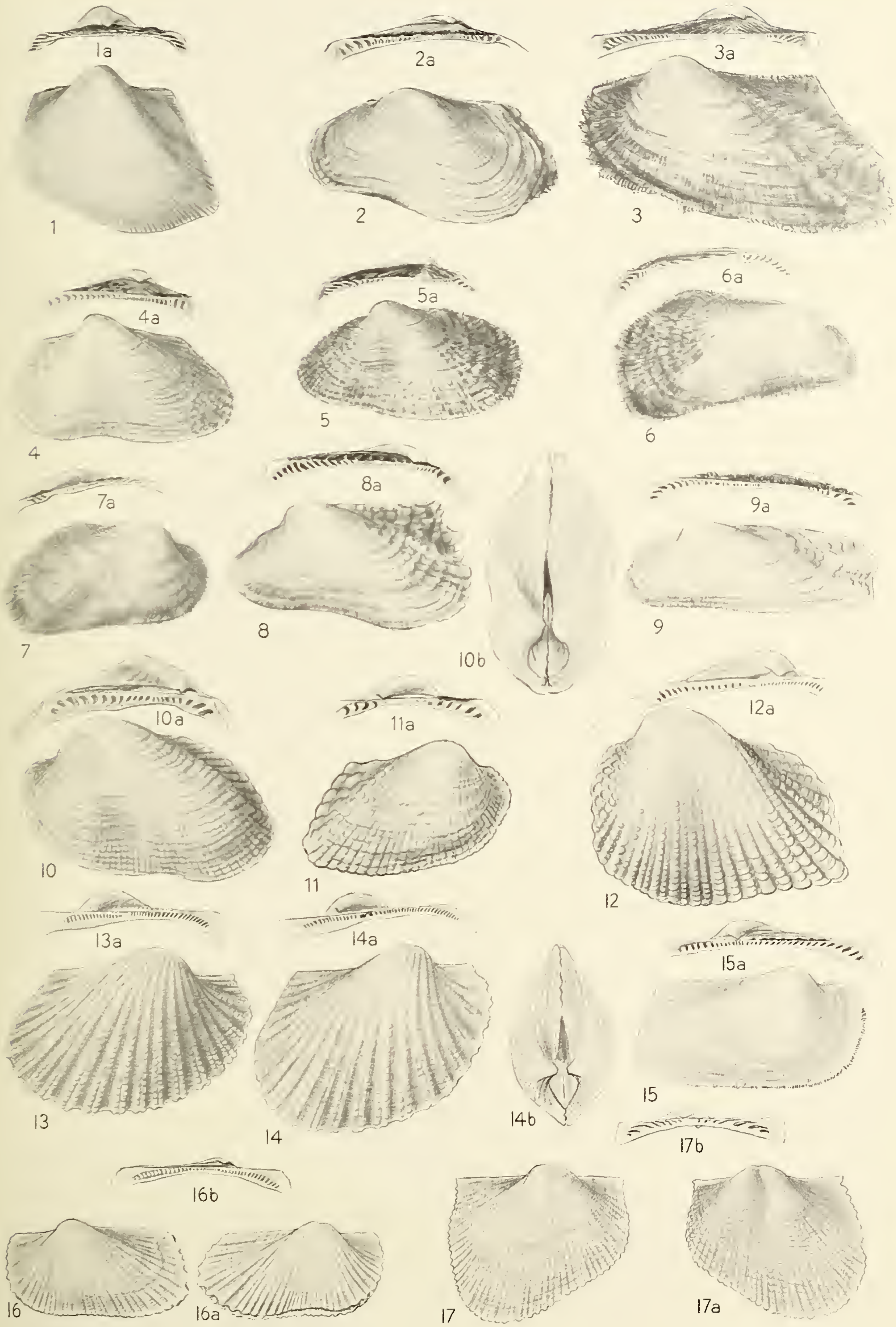
DESCRIPTION OF PLATE II.

Figs. 1, 1*a*.—*Cucullaea labiata petita* Iredale.
Figs. 2, 2*a*.—*Arca corallicola* Iredale.
Figs. 3, 3*a*.—*Arca multivillosa* Iredale.
Figs. 4, 4*a*.—*Arca parvivillosa* Iredale.
Figs. 5, 5*a*.—*Arca prolatens* Iredale.
Figs. 6, 6*a*.—*Savignyarca scazon* Iredale.
Figs. 7, 7*a*.—*Savignyarca benthicola* Iredale.
Figs. 8, 8*a*.—*Barbatirus mimulus* Iredale.
Figs. 9, 9*a*.—*Barbatirus terebrans* Iredale.
Figs. 10, 10*a*, 10*b*.—*Acar dubia* Baird.
Figs. 11, 11*a*.—*Acar iota* Iredale.
Figs. 12, 12*a*.—*Vitracar laterosa* Iredale.
Figs. 13, 13*a*.—*Mabellarca dautzenbergi* Lamy.
Figs. 14, 14*a*, 14*b*.—*Mabellarca dautzenbergi adjacens* Iredale.
Figs. 15, 15*a*.—*Mimarcaria saviolum* Iredale.
Figs. 16, 16*a*, 16*b*.—*Miratacar wendti michaelis* Iredale.
Figs. 17, 17*a*, 17*b*.—*Cucullaea labiata petita* Iredale, juvenile.



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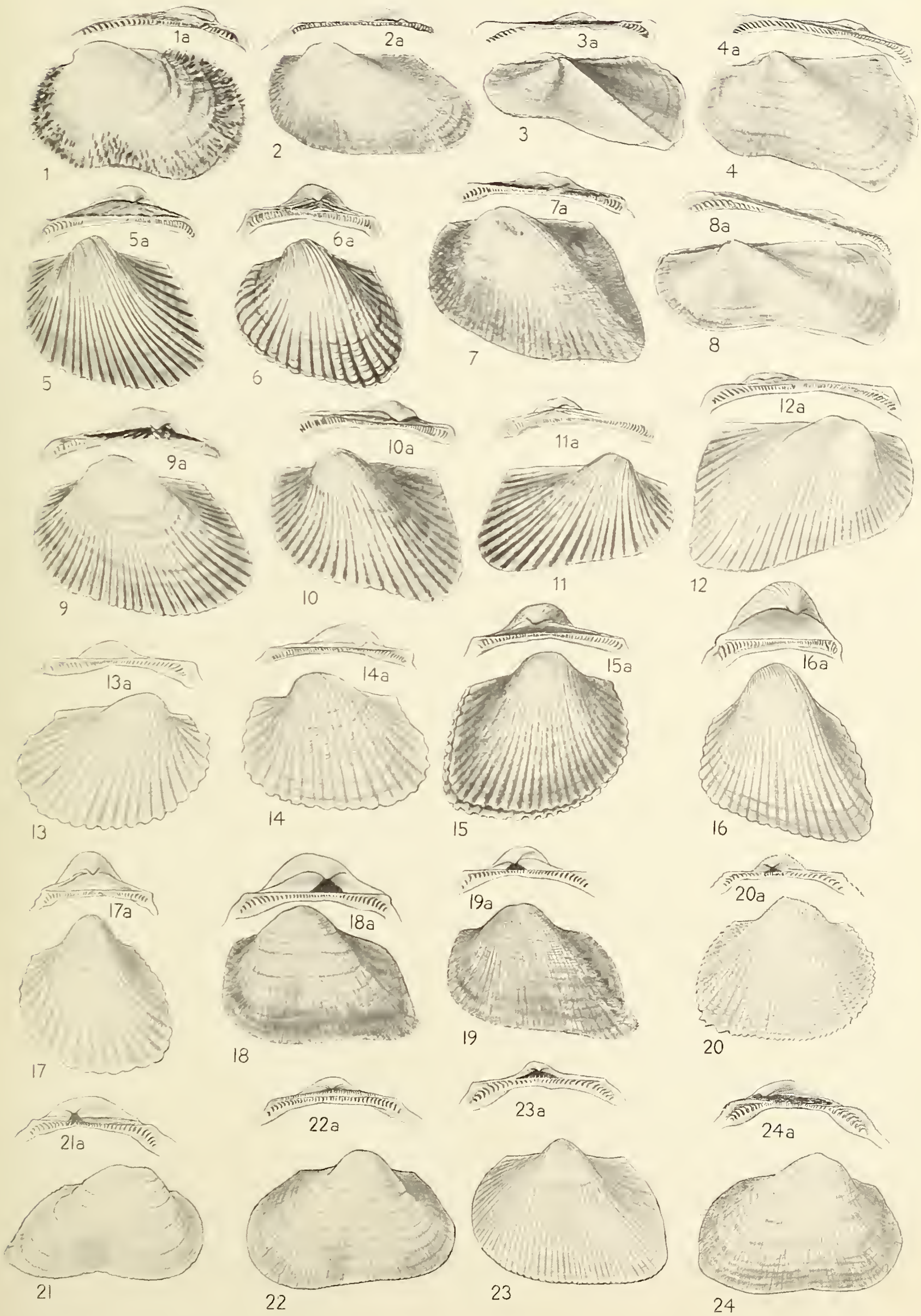
DESCRIPTION OF PLATE III.

Figs. 1, 1*a*.—*Ustularca cruciata renuta* Iredale.
Figs. 2, 2*a*.—*Opularca tenella egenora* Iredale.
Figs. 3, 3*a*.—*Trisidos yongei* Iredale.
Figs. 4, 4*a*.—*Trisidos semitorta* Lamarck.
Figs. 5, 5*a*.—*Anadara suggesta* Iredale.
Figs. 6, 6*a*.—*Anadara trapezia posita* Iredale.
Figs. 7, 7*a*.—*Anadara exulta* Iredale.
Figs. 8, 8*a*.—*Trisidos tortuosa* Linné.
Figs. 9, 9*a*.—*Anadara crebricostata* Reeve.
Figs. 10, 10*a*.—*Anadara nugax* Iredale.
Figs. 11, 11*a*.—*Anadara jurata* Iredale.
Figs. 12, 12*a*.—*Anadara exulta* Iredale, juvenile.
Figs. 13, 13*a*.—*Mabellarca ? disessa* Iredale.
Figs. 14, 14*a*.—*Mabellarca ? fortunata* Iredale.
Figs. 15, 15*a*.—*Scapharca aliena* Iredale.
Figs. 16, 16*a*.—*Anadara passa* Iredale.
Figs. 17, 17*a*.—*Potiarca pilula saccula* Iredale.
Figs. 18, 18*a*.—*Gabinarca pellita* Iredale.
Figs. 19, 19*a*.—*Gabinarca protrita* Iredale.
Figs. 20, 20*a*.—*Spinearca deliciosa* Iredale.
Figs. 21, 21*a*.—*Mulinarca aceraea* Melvill and Standen.
Figs. 22, 22*a*.—*Estellacar saga* Iredale.
Figs. 23, 23*a*.—*Verilarca bivia* Iredale.
Figs. 24, 24*a*.—*Didimacar repenta* Iredale.



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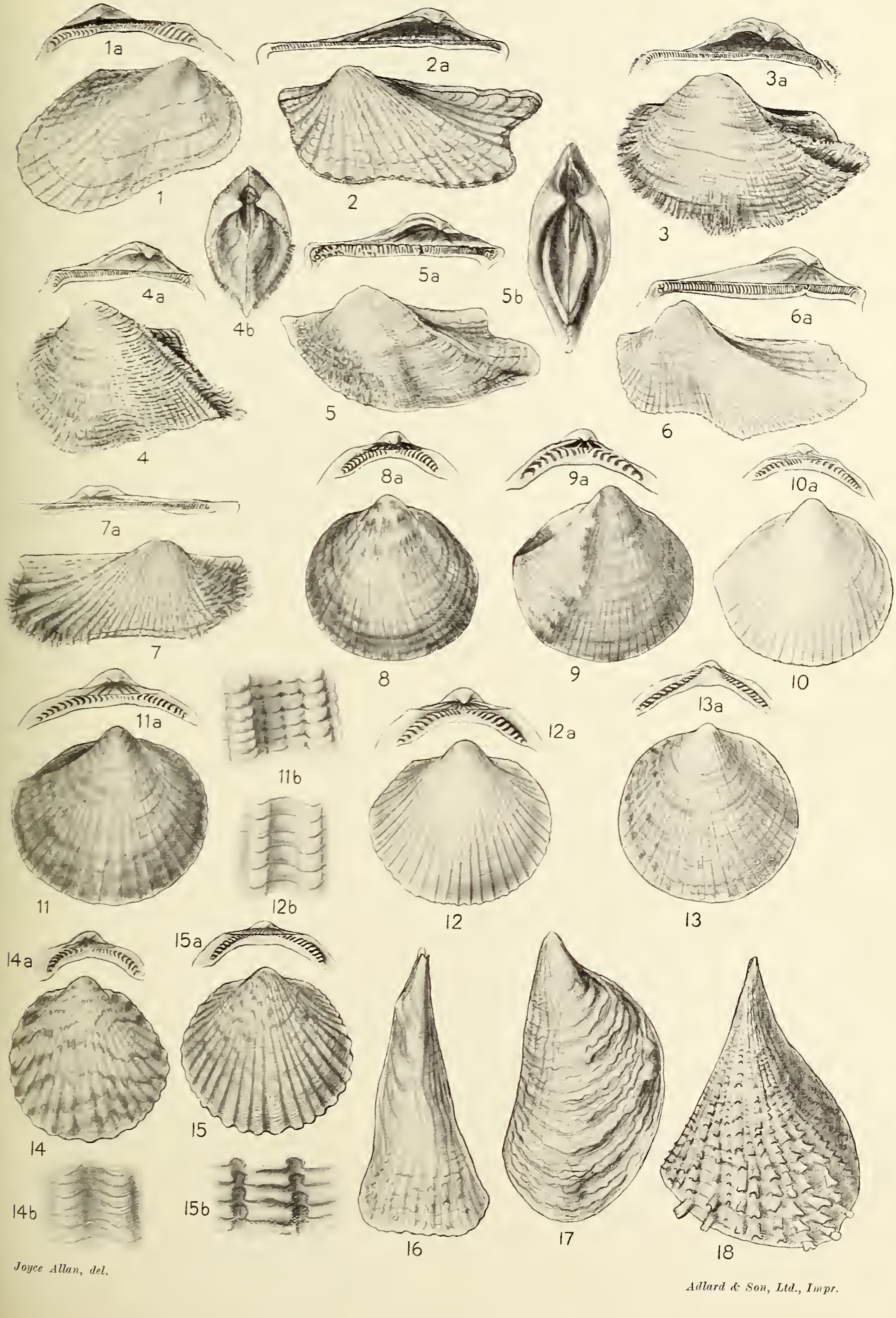
DESCRIPTION OF PLATE IV.

FIGS. 1, 1*a*.—*Barbatiella venustopsis* Iredale.
FIGS. 2, 2*a*.—*Navicula subnavicularis* Iredale.
FIGS. 3, 3*a*.—*Navicula aladdin* Iredale.
FIGS. 4, 4*a*, 4*b*.—*Navicula terebra* Iredale.
FIGS. 5, 5*a*, 5*b*.—*Navicula parventricosa* Iredale.
FIGS. 6, 6*a*.—*Navicula ventricosa* Lamarck.
FIGS. 7, 7*a*.—*Mesocibota luana* Iredale.
FIGS. 8, 8*a*.—*Veletuceta impasta* Iredale.
FIGS. 9, 9*a*.—*Veletuceta cotinga* Iredale.
FIGS. 10, 10*a*.—*Veletuceta queenslandica* Hedley.
FIGS. 11, 11*a*, 11*b*.—*Tucetilla tenuicostata* Reeve.
FIGS. 12, 12*a*, 12*b*.—*Tucetilla capricornea* Hedley.
FIGS. 13, 13*a*.—*Melaxinaea litoralis* Iredale.
FIGS. 14, 14*a*, 14*b*.—*Tucetona amboinensis extra* Iredale.
FIGS. 15, 15*a*, 15*b*.—*Tucetona hoylei superior* Iredale.
FIG. 16.—*Quantulopinna delsa* Iredale.
FIG. 17.—*Exitopinna deltodes ultra* Iredale.
FIG. 18.—*Atrina gouldii banksiana* Iredale.

PLATE IV.



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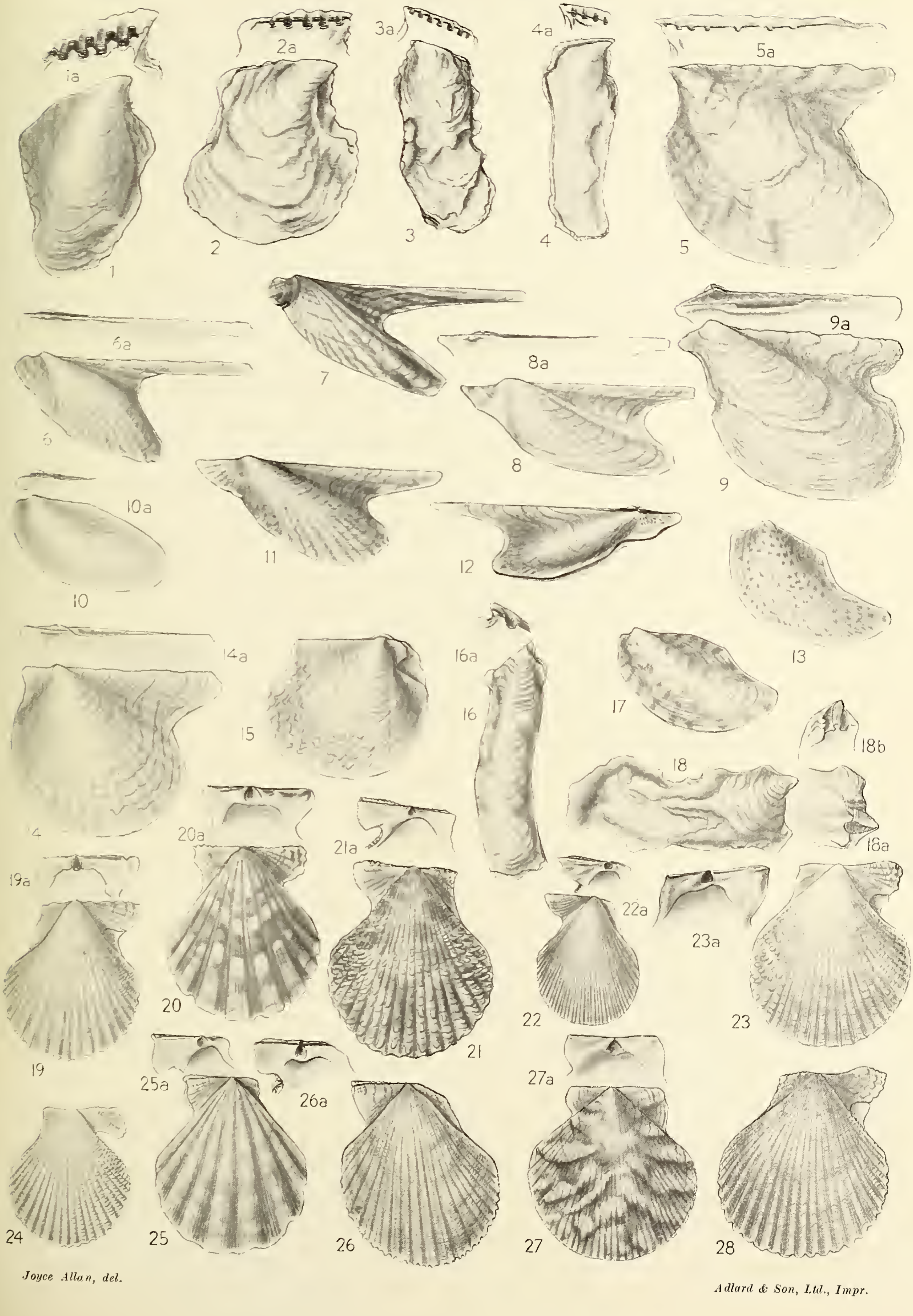
DESCRIPTION OF PLATE V.

FIGS. 1, 1*a*.—*Parviperna perexigua* Iredale.
FIGS. 2, 2*a*.—*Parviperna albisoror* Iredale.
FIGS. 3, 3*a*.—*Malleoperna intricata* Iredale.
FIGS. 4, 4*a*.—*Malleoperna paucidentata* Iredale.
FIGS. 5, 5*a*.—*Melina periculosa* Iredale.
FIGS. 6, 6*a*.—*Austropteria perscitula* Iredale.
FIG. 7.—*Austropteria antelata* Iredale.
FIGS. 8, 8*a*.—*Austropteria bernhardi* Iredale.
FIGS. 9, 9*a*.—*Austropteria maccullochi* Iredale.
FIGS. 10, 10*a*.—*Electroma tragulata* Iredale.
FIG. 11.—*Austropteria calosoma* Iredale.
FIG. 12.—*Austropteria levitata* Iredale.
FIG. 13.—*Electroma tragulata* Iredale.
FIGS. 14, 14*a*.—*Pinctada epitheca* Iredale.
FIG. 15.—*Pinctada perrutila* Iredale.
FIGS. 16, 16*a*.—*Parimalleus gregarius* Iredale.
FIG. 17.—*Electroma pygmea* Iredale.
FIGS. 18, 18*a*, 18*b*.—*Parimalleus rex* Iredale.
FIGS. 19, 19*a*.—*Mimachlamys curtisiana* Iredale.
FIGS. 20, 20*a*.—*Bractechlamys evecta* Iredale.
FIGS. 21, 21*a*.—*Mimachlamys subgloriosa* Iredale.
FIGS. 22, 22*a*.—*Mimachlamys deliciosa* Iredale.
FIGS. 23, 23*a*.—*Mimachlamys grossiana* Iredale.
FIG. 24.—*Mimachlamys ellochena* Iredale.
FIGS. 25, 25*a*.—*Complicachlamys wardiana* Iredale.
FIGS. 26, 26*a*.—*Coralichlamys acroporicola* Iredale.
FIGS. 27, 27*a*.—*Juxtamusium oblectatum* Iredale.
FIG. 28.—*Mimachlamys gavena* Iredale.



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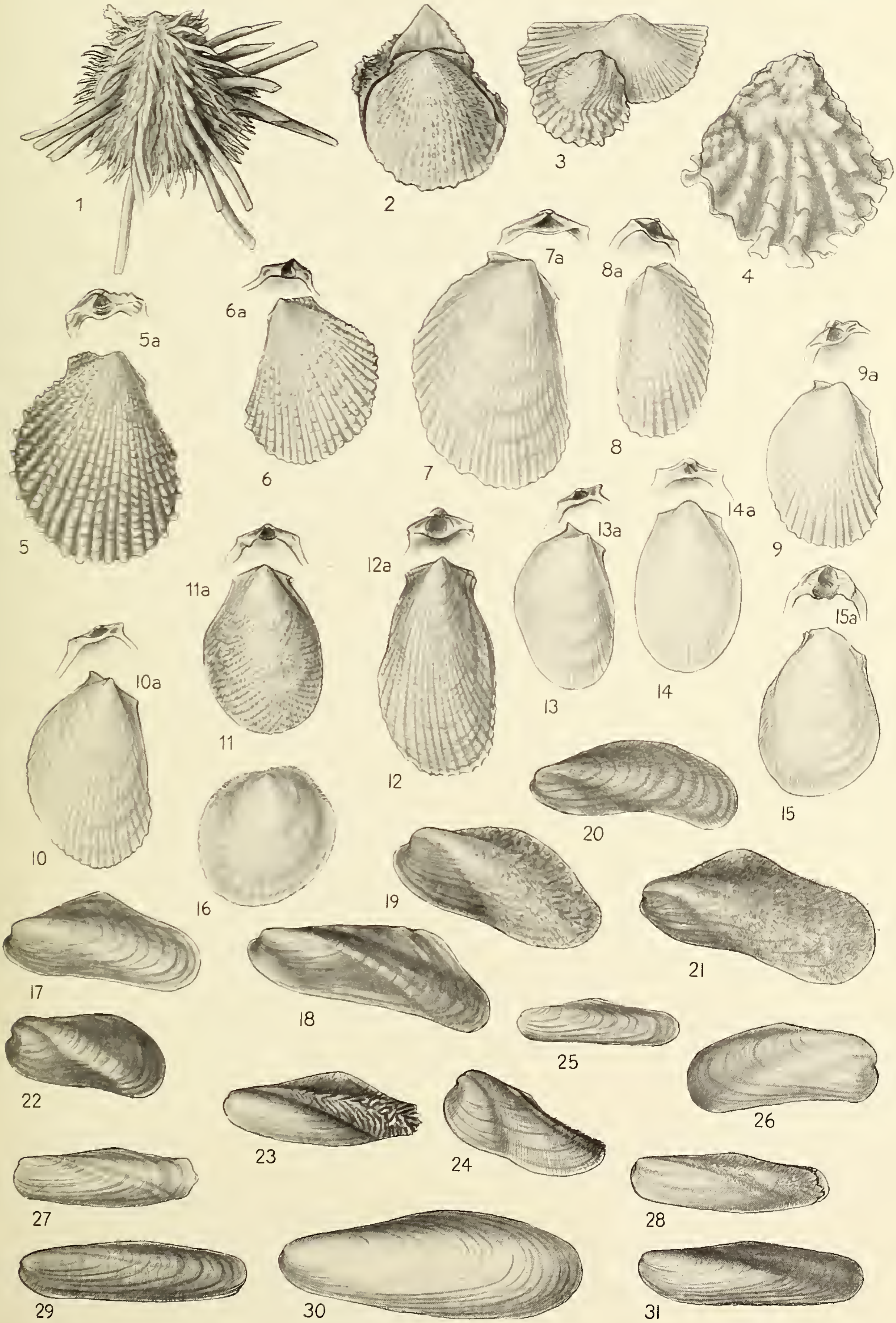
DESCRIPTION OF PLATE VI.

FIG. 1.—*Spondylus wrightianus ella* Iredale.
FIG. 2.—*Spondylus ducalis* Bolten.
FIGS. 3, 4.—*Plicatula essingtonensis* Sowerby.
FIGS. 5, 5*a*.—*Lima persquamifer* Iredale.
FIGS. 6, 6*a*.—*Austrolima tropicalis* Iredale.
FIGS. 7, 7*a*.—*Promantellum vigens* Iredale.
FIGS. 8, 8*a*.—*Promantellum stertum* Iredale.
FIGS. 9, 9*a*.—*Promantellum noverca* Iredale.
FIGS. 10, 10*a*.—*Promantellum parafragile* Iredale.
FIGS. 11, 11*a*.—*Ctenoides ferescabra* Iredale.
FIGS. 12, 12*a*.—*Stabilima tadena* Iredale.
FIGS. 13, 13*a*.—*Promantellum delicatule* Iredale.
FIGS. 14, 14*a*.—*Stabilima tensa* Iredale.
FIGS. 15, 15*a*.—*Ctenoides corallicola* Iredale.
FIG. 16.—*Monia timida* Iredale.
FIG. 17.—*Modiolus penelegans* Iredale.
FIG. 18.—*Modiolus ostentus* Iredale.
FIG. 19.—*Modiolus proclivis* Iredale.
FIG. 20.—*Dentimodiolus sculptus* Iredale.
FIG. 21.—*Modiolus agripeta* Iredale.
FIG. 22.—*Modiolus pulvillus* Iredale.
FIG. 23.—*Lithophaga divaricalx* Iredale.
FIG. 24.—*Tibialectus otteri* Iredale.
FIG. 25.—*Lithophaga simplex* Iredale.
FIG. 26.—*Botulopa silicula infra* Iredale.
FIG. 27.—*Lithophaga laevigata instigans* Iredale.
FIG. 28.—*Lithophaga calcifer* Iredale.
FIG. 29.—*Lithophaga teres annectans* Iredale.
FIG. 30.—*Lithophaga obesa suspecta* Iredale.
FIG. 31.—*Lithophaga dichroa* Iredale.



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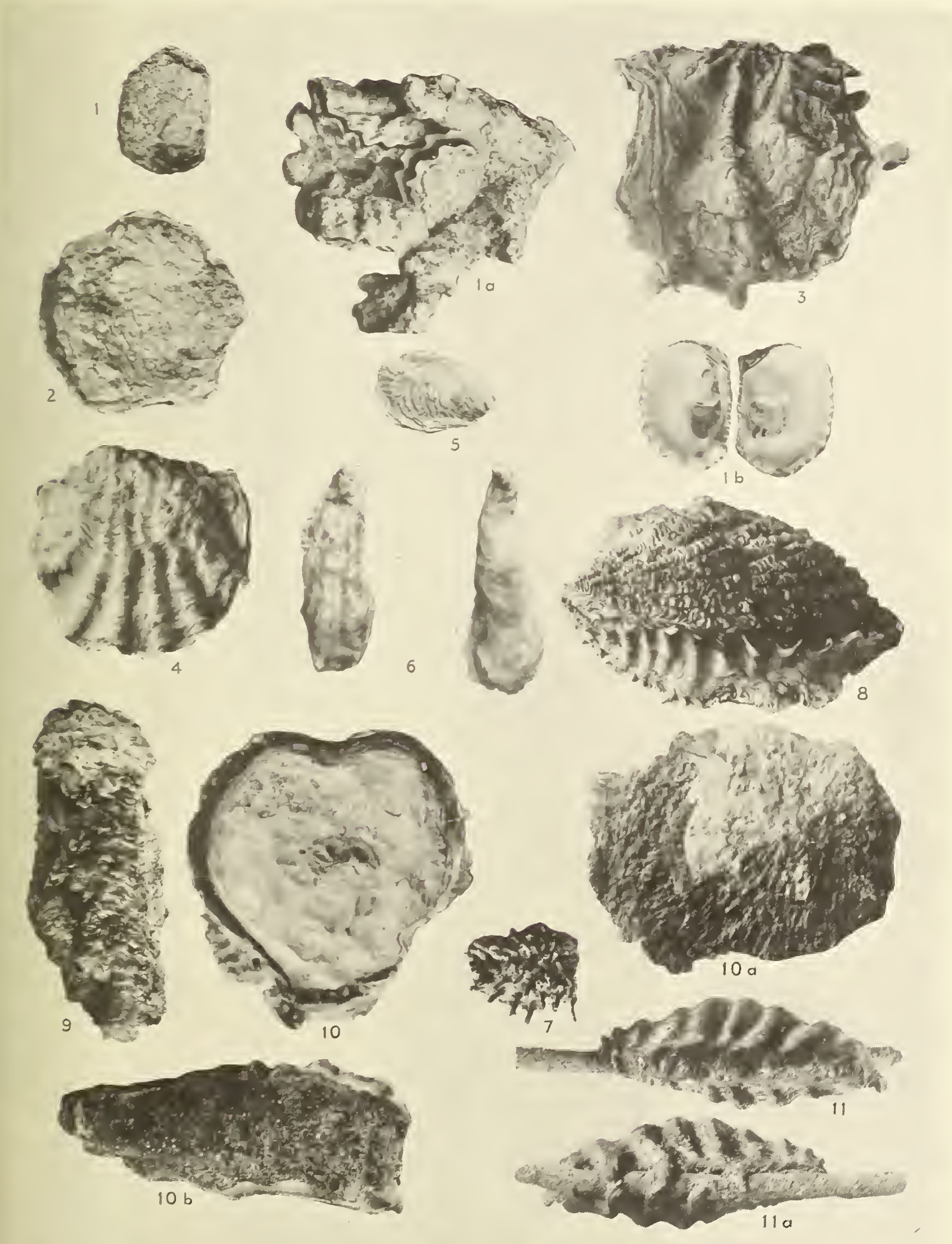
DESCRIPTION OF PLATE VII.

FIGS. 1, 1*a*, 1*b*.—*Ostrea nomades* Iredale.
FIG. 2.—*Ostrea procles* Iredale.
FIG. 3.—*Ostrea quirites* Iredale.
FIG. 4.—*Ostrea bresia* Iredale.
FIG. 5.—*Ostrea sedea* Iredale.
FIG. 6.—*Saxostrea commercialis dactylena* Iredale.
FIG. 7.—"*Ostrea spinosa.*"
FIG. 8.—*Saxostrea amasa* Iredale.
FIG. 9.—*Saxostrea* (*cornucopiaeformis*) Saville-Kent.
FIGS. 10, 10*a*, 10*b*.—*Saxostrea gradiva* Iredale.
FIGS. 11, 11*a*.—*Dendostraea folium* Linné.



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GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

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VOLUME V. No. 7

ACTINIARIA AND CORALLIMORPHARIA

BY

OSKAR CARLGREN

WITH TWENTY-EIGHT TEXT-FIGURES

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ACTINIARIA AND CORALLIMORPHARIA

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WITH TWENTY-EIGHT TEXT-FIGURES.

Our knowledge of the Actiniaria and Corallimorpharia of the Great Barrier Reef is based on the works of Saville-Kent (1893, 1897) and of Haddon (1898). Saville-Kent unfortunately describes and figures only the external features of his species; and the descriptions made by Haddon of the forms from the adjacent tropical waters of the Torres Straits are also rather incomplete, though he gives some notes about their anatomy. Undoubtedly, however, the waters from New Guinea to southern Queensland have most of their genera and a number of species in common. The collection examined by me contains the two species of Corallimorpharia and twenty-two of Actiniaria which are listed below; but Stephenson (1931, p. 47) mentions also *Thalassianthus* (?) *hypnoides* Sav.-Kent, and in a letter to me *Actineria dendrophora* Hadd. & Shackl., which according to him are probably identical species.

Actiniaria.

Edwardsia stephensoni n. sp.
Edwardsia gilbertensis Carlgr.
Charisella annulata (n. gen.), n. sp.
Triactis cincta (Hadd, & Shackl.).
Isactinia ignota n. sp.
Isactinia lobata n. sp.
Gyrostoma hertwigi Kwietn.
Actinodendron plumosum Hadd.
Phymanthus muscosus Hadd. & Shackl.
Heteranthus verruculatus Klunz.
Heterodactyla hemprichii Ehr.
Cryptodendrum adhesivum Klunz.
Stoichactis Kenti (Hadd. & Shackl.).
Stoichactis haddoni (Saville-Kent).
Hormathianthus tuberculatus Carlgr.
Calliactis miriam (Hadd. & Shackl.).
Telmatactis stephensoni n. sp.
Telmatactis australiensis n. sp.
Telmatactis insignis n. sp.
Epiphellia anneae (n. gen.), n. sp.
Epiphellia elongata n. sp.
Anthothoë australiensis n. sp.

Corallimorpharia.

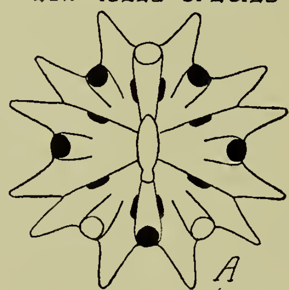
Rhodactis Howesii Saville-Kent.
Rhodactis (*Actinotryx*) *bryoides* (Hadd. & Shack.).

ACTINIARIA.

Fam. Edwardsiidae.

Edwardsia stephensoni n. sp.

Nemathybomes scattered, rather small. Tentacles usually 20, arranged in three cycles, 5 + 3 + 12. The ventral directive tentacle belongs to the first cycle, the dorsal directive tentacle to the second cycle. Retractors of the macrocnemes strong but diffuse, with numerous folds which are high and branched, especially in their outermost parts. The outer, lamellar part of the macrocneme is attached to the retractor far from its edge. Parietal muscles elongate, forming many fine folds. The extension of the parietal muscles on the column is considerable. Nematocysts of the nemathybomes 36–46·5 × 2·8–3μ; those of the tentacles (14) 17–29·6 × 2·2–3·5μ, basitrichs; those of the actinopharynx partly 15·5–22·6 × 2·2–2·8μ, partly 25·1–38 × 3–4·2μ, both basitrichs; those of the



Text-fig. 1.—*Edwardsia stephensoni* n. sp. First cycle of endocoelic tentacles, black spots; second cycle circles. (After Stephenson; reproduced by permission of the Ray Society).

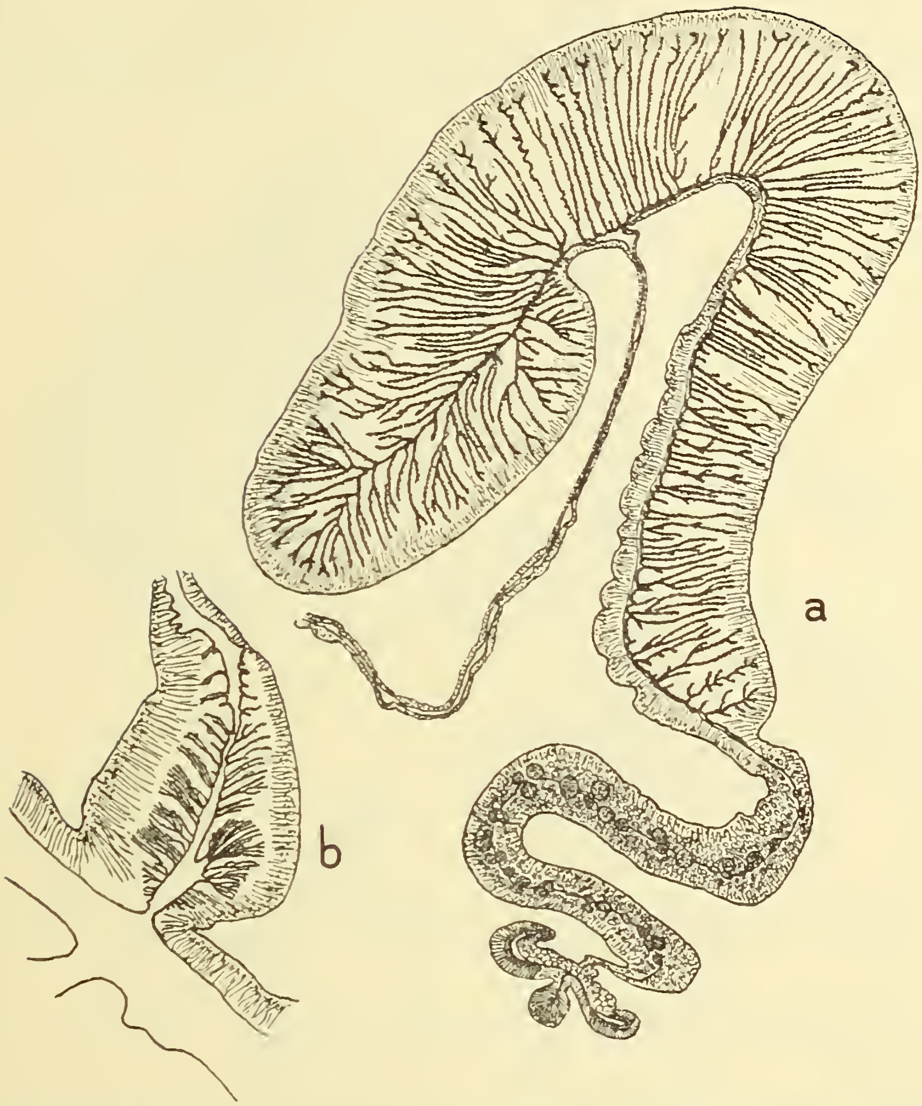
filaments partly 22·6–32·4 × 4·2–5·6μ, microbasic *p*-mastigophors, partly 24–37 × 3·5–4·5μ, partly 12·7–24 × 2·8μ, both basitrichs.

Colour in the preserved condition.—Tentacles of one specimen green.

Size of a large specimen, in introverted condition.—Length 8 cm., greatest diameter 0·8 cm.

Occurrence.—Low Isles, 23.viii.28, 2 specimens; 10.iv.29, 5 specimens; central flat, 22.viii.28, 1 specimen.

This species is related to *Edwardsia duodecimtentaculata* (Carlgren, 1931, p. 4), but the arrangement and number of tentacles is not the same as in that species. Professor T. A. Stephenson made a sketch from the living animal showing the arrangement of the tentacles; this is reproduced here as Text-fig. 1. Text-fig. 2 shows sections of a retractor (a) and of a parietal muscle (b), both taken from a macrocneme in the uppermost part of the fertile region. The nematocysts were examined in 5 specimens and show little variation from one individual to another.

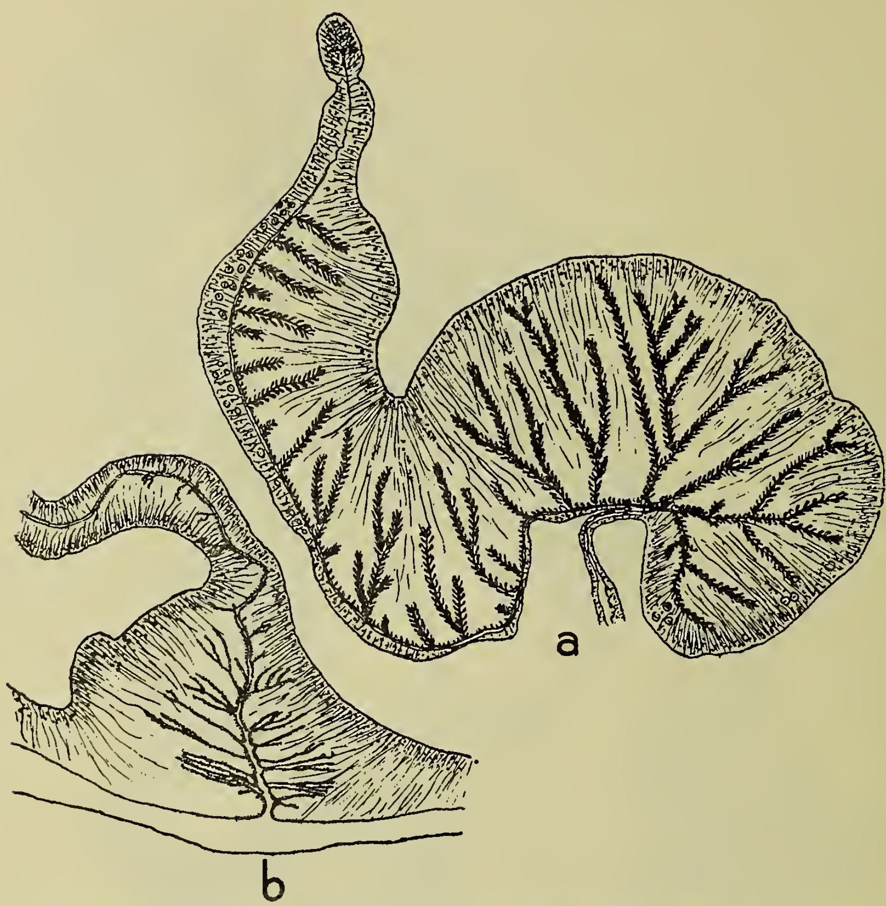


TEXT-FIG. 2.—*Edwardsia stephensoni* n. sp. Transverse sections of (a) retractor muscle and (b) parietal muscle from a macrocneme in the uppermost part of the fertile region.

Edwardsia gilbertensis Carlgr.

Edwardsia gilbertensis Carlgren, 1931, p. 10, figs. 7–9.

I have, with some hesitation, referred the present specimens of *Edwardsia* to *gilbertensis*. The body is strongly polygonal. The number of tentacles is 16–20, as in that species, and the retractors and parietal muscles agree rather well with those of *gilbertensis*. The nematocysts of the nemathybomes in the present specimens are somewhat longer, 38·1–49·3 × about 28μ ; those of the tentacles (11·3) 15·5–25·4 × 2·2–2·8μ, basitrichs ; those of the filaments partly 25·4–46·5 × 5·6–7μ, microbasic p-mastigophors, partly 28·2–38·1 × 4·2–5·6μ, partly 14–26 × 2·2–2·8μ, both basitrichs. Three specimens from different localities were examined for nematocysts. The endoderm is provided with numerous zooxanthellae.



TEXT-FIG. 3.—*Edwardsia gilbertensis* Carlgren (?). Transverse sections of (a) retractor muscle and (b) parietal muscle at the level of the uppermost part of the cnido-glandular tract.

SIZE of the largest specimen in introverted condition.—Length 4 cm., greatest diameter 0·4 cm.

OCCURRENCE.—Low Isles, 23. viii. 28, 2 specimens; 10. iv. 29, 1 specimen; 20. iv. 29, several specimens. Further distribution: Tapetoca, Taritari or Apaiang, Key Islands.

Text-fig. 3 shows sections of a retractor (a) and a parietal muscle (b) at the level of the uppermost part of the cnido-glandular tract.

Fam. CONDYLANTHIDAE.

Genus *Charisella.*

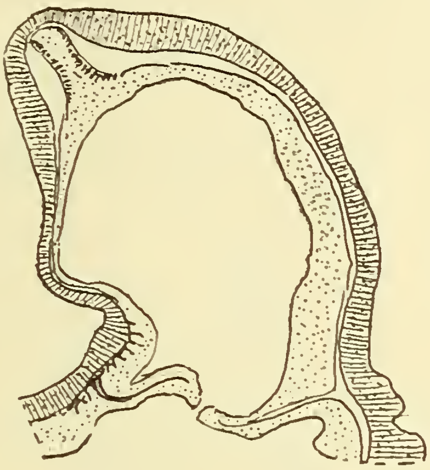
Charisella n. gen., Carlgren, 1949, p 46.

Condylanthidae with elongate, cylindrical column not divisible into regions, smooth. At the margin a ring of pseudospherules. Sphincter endodermal, diffuse, very weak. Tentacles about 48 in number, short, hexamerously arranged, their longitudinal muscles ectodermal. Two distinct siphonoglyphs. Mesenteries divisible into macro- and microcnemes. Two cycles of macrocnemes, one of microcnemes, the latter weak and thin. Cnidom: spirocysts, basitrichs, microbasic *p*-mastigophors.

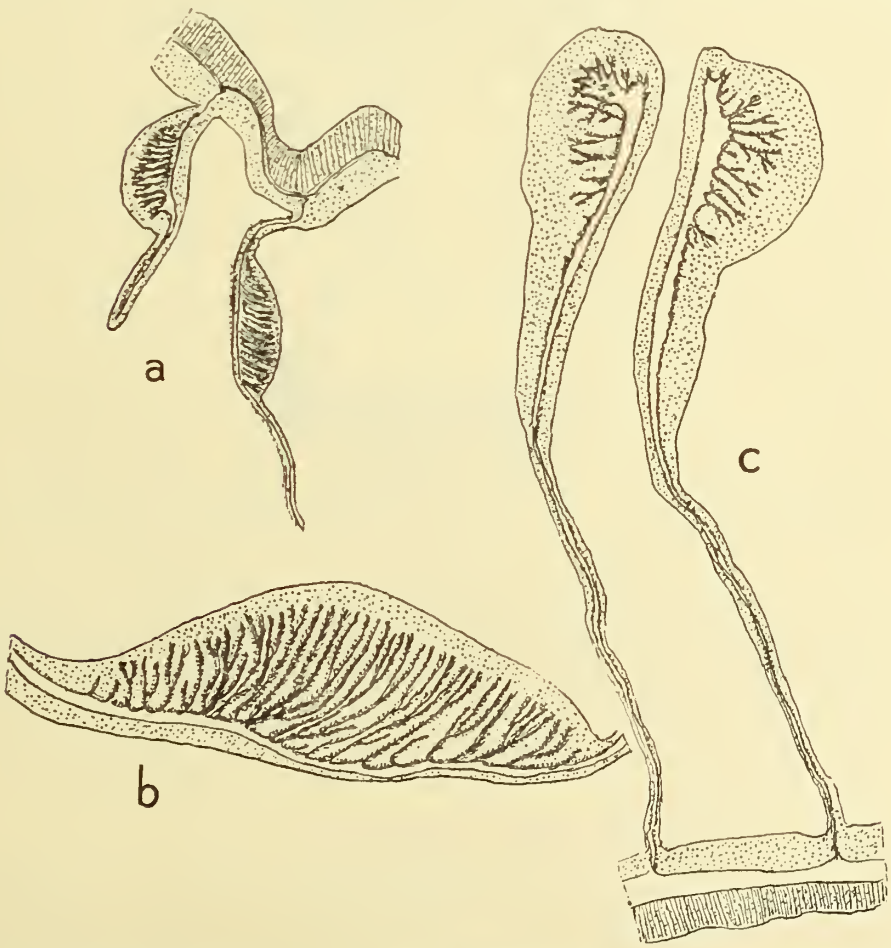
GENOTYPE.—

C. elongata n. sp.

Aboral end small. Column cylindrical, smooth, without a cuticule, provided at the margin with a ring of perforated pseudospherules. A very weak diffuse sphincter. Ten-

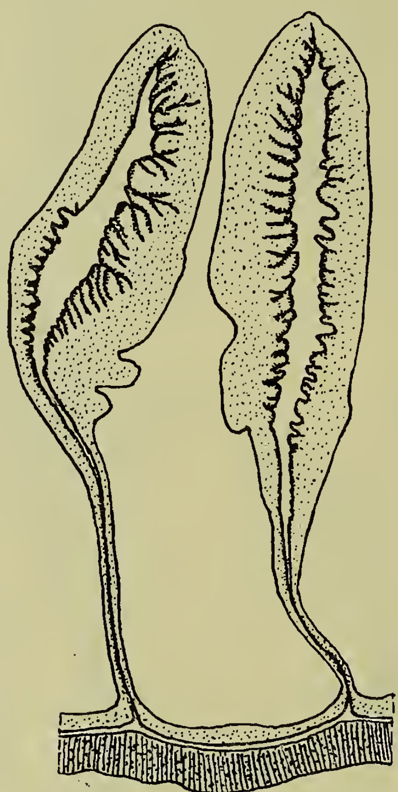


TEXT-FIG. 4.—*Charisella elongata* n. sp. Section of the uppermost part of the column.



TEXT-FIG. 5.—*Charisella elongata* n. sp. Cross sections of directive mesenteries. (a) Two directives with corresponding siphonoglyph. (b) A single directive. (c) Two directives near the base of the animal.

tacles about 48, short, their longitudinal muscles ectodermal. Actinopharynx with numerous high folds. Two distinct siphonoglyphs. Pairs of mesenteries 48 ; two pairs of directives. Mesenteries of the first and second cycles perfect and provided with retractors and filaments. Retractors of the mesenteries diffuse, somewhat restricted. Outer parts of the perfect mesenteries thin throughout, their muscles very weak. Near the base, the inner parts of the mesenteries are provided with longitudinal muscles on both sides. Microcnemes weak, thin. Basilar muscles distinct but rather weak. Number of mesenteries the same proximally and distally. Distribution of the gonads unknown. Nematocysts of the column 11·3–12·7 × about 2·2μ, basitrichs, common ; those of the



TEXT-FIG. 6.—*Charisella elongata* n. sp. Cross section of a pair of non-directive mesenteries near the base.

pseudospherules 5·6–10 × about 1·4μ, basitrichs ; those of the tentacles 12–14·1 × about 2·2μ, basitrichs ; those of the actinopharynx partly 18·3–21·1 (22·6) × 2·8–3·5μ, basitrichs, common, partly 16·9–20 × 4·2 (4·9)μ, microbasic *p*-mastigophors ; those of the filaments partly 25·4–31 × 2·8–3μ, common, partly 12·7–14·1 × 2·2–2·5μ, few, both basitrichs, partly (16·2) 18·3–21·1 × 3·5–4μ, microbasic *p*-mastigophors.

SIZE of the longer specimen.—Length about 2·5, cm. diameter 0·7 cm.; of the smaller : length 1·7 cm., diameter 0·6 cm.

OCCURRENCE.—Low Isles, 10.iv.29, 2 specimens.

Text-fig. 4 shows a section of the uppermost part of the column. The section has cut a marginal spherule, which is provided at its opening (not visible) with strong muscles. On the left the trace of a sphincter is visible ; this, however, is weaker on other slides. The mesenteries of the second cycle are attached to the actinopharynx only in its oral

part. Their filaments are considerably shorter than those of the mesenteries of the first cycle. I have drawn cross-sections of mesenteries in Text-figs. 5 and 6. Text-fig. 5a shows 2 directives with the corresponding siphonoglyph ; 5b a directive mesentery ; 5c two directives near the base of the animal, Text-fig. 6 a pair of non-directives near the base. The basilar muscles are weak, but certainly present. There are numerous zooxanthellae in the endoderm.

Fam. ALICIIDAE.

Triactis cincta (Hadd. & Shackl.).

Viatrix cincta n. sp., Haddon & Shackleton, 1893, p. 127.
Hoplophoria cincta (Hadd. & Shackl.), Haddon, 1898, pl. xxiii, figs. 11–15.
Phyllodiscus cinctus Hadd. & Shackl., Stephenson, 1922, p. 280; Stephenson and others, 1931, p. 38 ; Carlgren, 1940, p. 31, fig. 82.
Triactis cincta (Hadd. & Shackl.), Carlgren, 1945, p. 7, 1947, p. 14.
? *Phyllodiscus indicus* n. sp., Stephenson, 1921, p. 561, fig. 18.
? *Triactis producta* n. sp., Klunzinger, 1877, p. 85, pl. vi, fig. 8.

The pedal disc is well developed. The column is smooth, but around its middle there is a ring of outgrowths, each consisting of a peduncle which is ramified distally. The smallest specimens (3 mm. long) have no outgrowths, slightly larger ones have about 12 sparsely placed outgrowths. With increasing size new outgrowths are intercalated between the older ones so that finally a ruff-like circle of very close-set outgrowths is formed. On the peduncle (but not on the branches) large vesicles are present which may also be developed on the disal part of the column close to the peduncle. Usually the vesicles, which are provided with macrobasic amastigophors, are set at the end of the peduncle close to the branches ; but often they are present also at its base. The upper part of the column (the capitulum), above the outgrowths, is more thin-walled than the lower part, and somewhat narrower just above them and has ectodermal muscles and groups of spirocysts. The tentacles are hexamerously arranged and up to 48 in number. They are rather long, and provided with spots which are elongated transversely and therefore give the tentacles an annulate appearance. The spots contain numerous spirocysts and less numerous nematocysts. The siphonoglyphs are rather distinct. There are 6 pairs of perfect mesenteries and up to 18 pairs imperfect ; two pairs are directives. The retractors are weak, diffuse, with low folds ; the parietobasilar muscles very weak, forming a straight lamella. The specimens are seemingly sterile. As in *Phyllodiscus* and *Lebrunia*, the peduncles are provided with longitudinal muscle bands in the endoderm ; but they are very weak here, and there do not appear to be more than 4 in each peduncle. As to the distribution and types of the nematocysts, see Carlgren, 1945, p. 7.

According to Stephenson (1931) the species stings the fingers quite badly. The tentacles are usually kept partially or completely retracted in strong light, whereas the ruff of vesicles is widely expanded. In a dim light the reverse was the case. Text-fig. 18, given by Stephenson, (1921), of *Phyllodiscus indicus*, gives a good idea of the external feature of *Triactis cincta*.

COLOUR.—Vesicles brown, tentacles bluish white, during life (Stephenson).

SIZE of a large specimen.—Length about 1·5 cm., diameter 0·8 cm.

OCCURRENCE.—Low Isles, sandy pools, 19.iv and 22.iv.29, numerous specimens. It is possible that *T. cincta* is identical with *T. producta* Klunz., from the Red Sea (see Carlgren, 1947, p. 14).

Fam. Actiniidae.

Isactinia ignota n. sp.

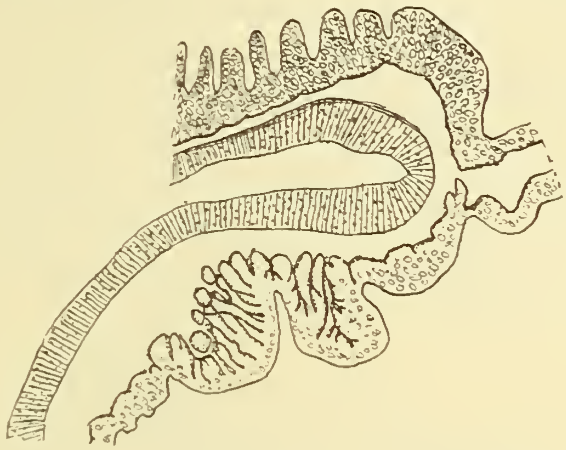
Anemonia citrina Hadd. & Shackl., Stephenson and others, 1931, p. 57.

The pedal disc is well developed, the column smooth, provided at the margin with a ring of well developed perforated pseudospherules. Upper part of the column and outer

Text-fig. 7.

Text-fig. 8.

part of the oral disc lobed in full-grown individuals. Sphincter somewhat restricted with rather long folds which are usually weaker in its middle part. The tentacles are of moderate length, in the older specimens numerous; their longitudinal muscles are ectodermal. There are considerably more tentacles than there are mesenteries at the limbus. The actinopharynx is folded, with 0–2 siphonoglyphs. At least 12 pairs of mesenteries are perfect. No directives, or 1–2 pairs. All stronger mesenteries are fertile. The retractors are band-like but not strong, the parietobasilar muscles weak,



TEXT-FIG. 9.

TEXT-FIG. 10.

TEXT-FIGS. 7–10.—*Isactinia ignota* n. sp. Sphincters of four specimens.

forming a single lamella on a fold of the mesentery. The nematocysts of the column are 18·3–26 × 2·5–3μ, basitrichs; those of the pseudospherules 18·3–25·4 × 2·5–3μ, basitrichs; those of the tentacles 14·1–19·7 × 2·8–3·5μ, basitrichs; those of the actinopharynx partly 16·8–22·6 (24) × 2·8–3·5μ, basitrichs, partly 16·9–21·8 × 4·2–5·6μ, microbasic *p*-mastigophors rare; those of the filaments partly 27–32·4 × (2·5) 3–4·2μ, partly 14–19 × 2·8μ scarce, both basitrichs, partly (14) 16–22·6 × 4·2–5·6μ, microbasic *p*-mastigophors.

COLOUR of the largest specimen (collected 22.iii.29) in the preserved condition, green; probably in connection with the presence of zooxanthellae in the endoderm. The specimens collected 1.ix.28 were greyish black when preserved.

Size of the largest specimen.—Pedal disc 2 cm., column (contracted) 3 cm., oral disc 3 cm.

Occurrence.—Low Isles, 1.ix.28, 6 specimens; 22.iii.29, 3 specimens; 17.iv.29, 1 specimen.

I have here figured the sphincters of 4 specimens, from all the samples, to show the similarity of the sphincters. The sphincters of three of the four specimens agree very well with one another, in as much as the muscle folds are shorter in the middle than in other parts, though the sphincter is very weak in the smallest specimen (Text-fig. 7), considerably stronger in the largest (Text-fig. 8), and intermediate in another (Text-fig. 9). Also the sphincter of the fourth specimen, collected 1.ix.28 (Text-fig. 10), differs little from the other sphincters.

I suggested previously that the species under discussion was *I. citrina* Hadd. & Shackl. (see Stephenson and others, 1931), but as the sphincter of this species shows an appearance unlike that of *citrina*, it is hardly possible to refer them to same species. Four specimens were examined as to the nematocysts; the larger specimens have slightly larger nematocysts than the smaller, but there is very little difference.

Isactinia lobata n. sp.

The pedal disc is wide, the column smooth; but owing to strong contraction it is transversely folded. At the margin is a ring of about 96 well-marked elongate pseudospherules, irregularly arranged. Uppermost part of column and outer part of oral disc strongly folded. Sphincter diffuse, but hardly indicated (Text-fig. 11), not as strong as the other endodermal muscles of the column. Circular muscles of the pseudospherules (p) very weak. Fosse distinct. The tentacles are rather short, up to about 400 in number, all of about the same length. Actinopharynx with numerous ridges, two siphonoglyphs not aborally prolonged. Many pairs of mesenteries perfect, 2 pairs of directires. Number of mesenteries at the base about half that of the tentacles. All stronger mesenteries, including the directives, fertile. Retractors of the strongest mesenteries band-like, those of the directives and the younger mesenteries somewhat restricted. Parietobasilar muscles distinct, on a fold of the mesentery. Nematocysts of the column $20{\cdot}4$–$25{\cdot}4 \times 2{\cdot}4$–$2{\cdot}8\mu$, numerous, basitrichs; those of the pseudospherules $19{\cdot}7$–$26{\cdot}8 \times 2{\cdot}5$–$2{\cdot}8\mu$, numerous, basitrichs; those of the tentacles $15{\cdot}5$–$18{\cdot}3 \times 2{\cdot}5$–$3\mu$, numerous, basitrichs; those of the actinopharynx $18{\cdot}3$–$22{\cdot}6 \times 3$–$3{\cdot}5\mu$, basitrichs; those of the filaments partly $18{\cdot}3$–$21{\cdot}1 \times 4{\cdot}2\mu$, microbasic *p*-mastigophors, partly $26{\cdot}8$–$29{\cdot}6 \times 4{\cdot}2\mu$, partly 21–$24 \times 2{\cdot}8\mu$, few, both basitrichs (also some small basitrichs about $10 \times 1{\cdot}5\mu$).

Colour during life.—Disc and tentacles in the main brown, the tips of the tentacles pale green, the pale green colour perhaps affecting the shaft of the tentacle also to some extent (notes in a letter from Professor T. A. Stephenson).

Size in a very contracted condition.—Height 2 cm., diameter of pedal disc about 2·8 cm.

Occurrence.—Low Isles, 9.xii.28, 1 specimen.

The uppermost part of the column and the outer part of the oral disc are thrown into 8 distinct lobes in the preserved specimen. Professor Stephenson has informed me that the tips of the tentacles were swollen into rounded knobs during life. In the preserved animal the tentacles are cylindrical and there are no indications of a " capitate " appear-

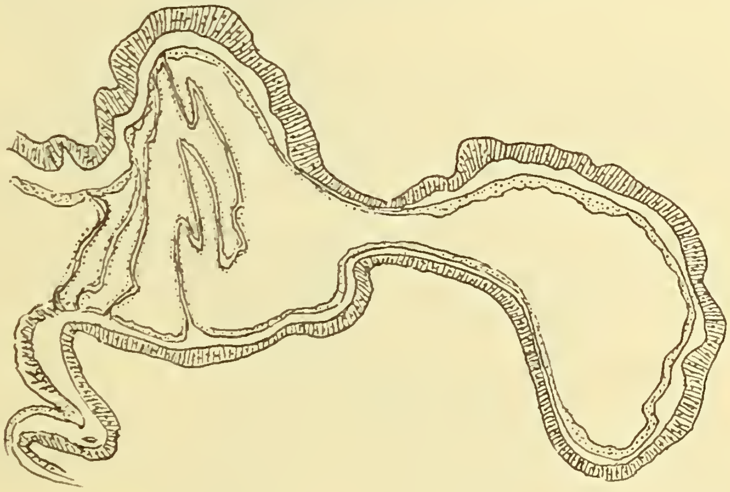
ance of the tentacles. The basitrichs of the tips of the tentacles are small, and agree in size with those of the lower parts of the tentacles. There are, thus, no large nematocysts present as in the case of capitate tentacles proper. According to Stephenson the tentacles were held over the disc in bunches so that they produced an unusual effect; they looked distinctly like the grape-like branches of the green alga, *Caulerpa racemosa.*

The species is closely related to *Isactinia* (*Anemonia*) *Kwoiam* (Hadd. & Shackl.), but I think that it is a distinct species, among other reasons because the appearance of the tentacles seems to be different.

Gyrostoma hertwigi Kwietniewski.

Gyrostoma hertwigi n. sp., Kwietniewski, 1897, p. 30; 1898, p. 424, pl. xxx, figs. 66–70.
Condylactis Ramsayi n. sp., Haddon and Shackleton, 1893, p. 124.
Anemonia ramsayi Hadd. & Shackl., Haddon, 1898, p. 420, pl. xxii, figs. 3, 4; pl. xxvi, figs. 6, 7.
Gyrostoma ramsayi, Stephenson and others, 1931, pp. 72, 87.

The pedal disc is wide, the column smooth, but owing to the strong contraction is transversely wrinkled. The fosse is well developed. Upper part of the column and outer

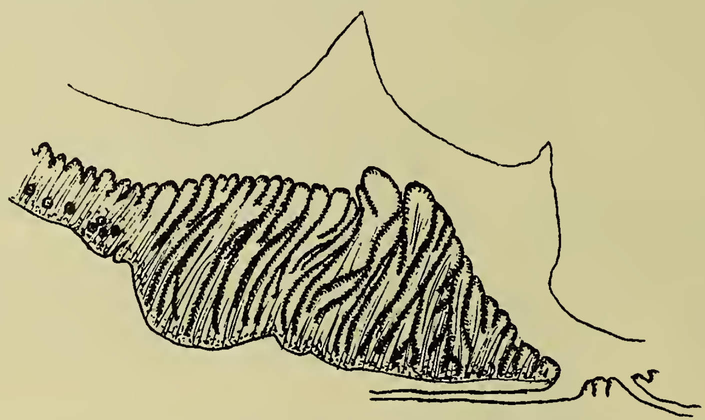


TEXT-FIG. 11.—Sphincter of *Isactinia lobata* n. sp.

part of the oral disc distinctly lobed. Sphincter diffuse, somewhat restricted. Text-fig. 12 shows a section of the sphincter which seems to agree very well with those drawn by Kwietniewski and Haddon in 1898. The tentacles are of moderate length, their longitudinal muscles ectodermal. The actinopharynx is folded. There are 7 siphonoglyphs corresponding to 7 pairs of directives in a specimen which was examined. A number of pairs of mesenteries are perfect. All stronger mesenteries, including the directives, seem to be fertile. The retractors are more or less band-like, as shown in the papers of Kwietniewski and Haddon. The parietobasilar muscles of the stronger mesenteries are situated on a distinct fold. The tentacles are more numerous than the mesenteries at the base, although it was difficult to determine the exact number of tentacles owing to their bladder-like appearance and the strong contraction of the oral disc. I counted about 140 mesenteries at the base and about 190–200 tentacles in one specimen; in another about 200 mesenteries and about 400 tentacles. Nematocysts of the column partly 22·6–28·2 × 3·5–4·2μ, basitrichs, common, partly 39·5–46·5 × 7–8μ, microbasic *p*-mastigophors,

scarce; those of the tentacles 19·7–28·2 × 3·5–5·6μ, basitrichs, common; those of the actinopharynx partly 24–29·6 × 7μ, microbasic *p*-mastigophors, scarce, partly 18·3–25·4 × 3–3·5μ, common, partly 10·6–14 × about 2μ, rare, both basitrichs; those of the filaments partly 21–31 × 5–7μ, microbasic *p*-mastigophors, common, partly 22·6–25·4 × 4–4·5μ, rare, partly 12–14 × 2·8μ, both basitrichs.

COLOUR in the preserved condition.—Column brown, tentacles and oral disc greenish.



TEXT-FIG. 12.—Sphincter of *Gyrostoma hertwigi* Kwietniewski.

SIZE of the largest specimen in the contracted condition.—Height 3 cm., pedal disc 3·5 cm., oral disc 4 cm. According to Stephenson the species may reach more than 18 in. in diameter.

OCCURRENCE.—Three Isles, 6.v.1929, 3 specimens; Lizard Island (Stephensons, Tandy and Spender). Further distribution: Thursday Island, Murray Islands.

Fam. ACTINODENDRIDAE.

Actinodendron plumosum Hadd.

Actinodendron plumosum n. sp., Haddon, 1898, p. 490, pl. xxiv, figs. 3–6.
Actinodendron plumosum Hadd., Stephenson and others, 1931, pp. 44, 47, 50, 54, 55; Carlgren, 1945, p. 51.
Actinodendron arboreum (Quoy & Gaim.), Haddon & Shackleton, 1893, p. 117.
Actinodendron alcyonidium Saville-Kent, 1893, p. 34, 146, pl. xxii; 1897, p. 223, fig. p. 224.

The anatomy of this species agrees with that of *A. hansingorum* (Carlgren, 1900, p. 118). I have made sections of the smaller specimen. There are 2 very strong siphonoglyphs with well-developed aboral prolongations. The pairs of mesenteries are 24 (6 + 6 + 12), the retractors are band-like, and on the non-directives are often curved towards the exocoels. As to the nematocysts, see Carlgren, 1945, p. 15.

COLOUR in life.—Bright reddish brown, etc. (Stephenson). Stephenson and others, 1931, pl. xx, fig. 1, have given a good photograph of this species; see also Haddon and Saville-Kent.

SIZE of the larger specimen in the contracted condition.—Pedal disc 3·5 cm., height 6 cm.; of the smaller specimen: pedal disc 0·7 cm., height 4·5 cm.

OCCURRENCE.—Low Isles, 15.iv.29, 2 specimens. Further distribution: Torres Straits, Mer, Cape York and Lacapade Islands (W. Australia).

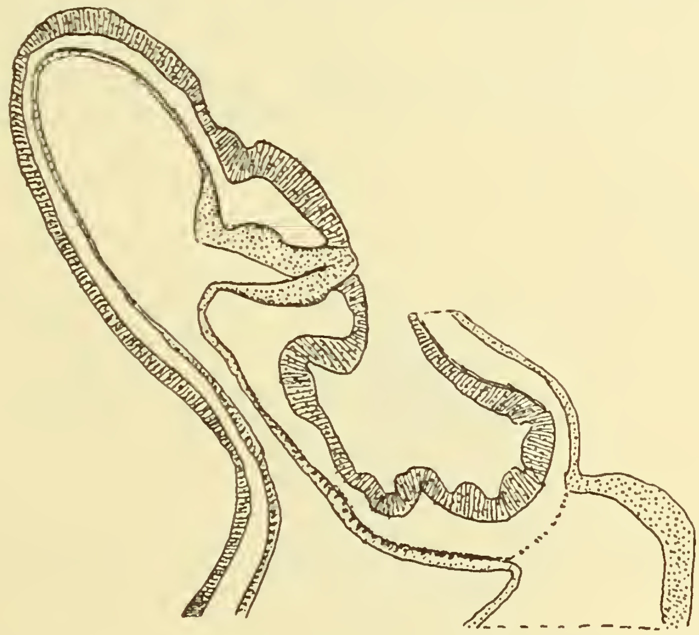
Possibly *plumosum* and *hansingorum* are indentical.

Fam. PHYMANTHIDAE.

Phymanthus muscosus Hadd. & Shackl.

Phymanthus muscosus n. sp., Haddon and Shackleton, 1893, p. 122.
Phymanthus muscosus Saville-Kent, 1893, p. 149, Pl. iii, fig. 5.
Phymanthus muscosus Hadd. & Shackl., Haddon, 1898, pl. xxv, figs. 10–14; pl. xxxi, fig. 9.
Phymantus sp. ? Carlgren, 1940, p. 35; Stephenson and others, 1931, p. 56.

There are three specimens in the collection, two of which are smaller than the third and probably not full-grown. I have identified them with *Phymanthus muscosus* Hadd. and Shackl. Haddon described the external features and certain anatomical details in 1898. All three specimens have perforated pseudospherules (Text-fig. 13) at the margin. There is no distinct sphincter. It is true that the endodermal muscles show short folds at the place where a sphincter usually occurs, but these folds are not stronger than those



TEXT-FIG. 13.—Pseudospherule of *Phymanthus mucosus* Haddon and Shackleton.

below the pseudospherules, the muscles of which are very weak. The marginal tentacles of the smaller specimens have fewer appendages than those of the large specimen, but even the appendages of the latter seem to be less strongly dendritic than in the type, probably owing to the degree of contraction. The marginal tentacles are about 96 in number, but there are half as many mesenteries at the base. The two siphonoglyphs are aborally prolonged. In one small specimen the mesenteries of the first and second cycles are perfect, in the large specimen at least a part of the third cycle also. In the small individual sectioned the mesenteries of the first cycle (apart from the two directives) are fertile; in the large specimen all mesenteries of the two first cycles are provided with reproductive organs. The retractors are strong, band-like, diffuse, with high folds, and on the directives are curved towards the endocoels, on the non-directives towards the exocoels. The parietobasilar muscles are well developed and set on a fold.

The nematocysts of the column are 12–19 $\times$ 2–2·5μ, basitrichs; those of the pseudospherules 14–18·3 $\times$ 2–2·5μ, basitrichs; those of the tentacles 13–20 $\times$ 2·2–2·5μ, common,

basitrichs; those of the actinopharynx partly 13·4–24 × 2·2–2·8μ, probably two sorts, basitrichs, partly 19–22·6 × 4·2μ, microbasic *p*-mastigophors; those of the filaments partly 25·4–33·8 ×3·5–4·5μ, partly 10–14·4 × 2·2μ, both basitrichs, partly 17·6–22·6 × (3) 4·2μ, microbasic *p*-mastigophors. All three specimens were examined for nematocysts.

COLOUR.—See Haddon and Shackleton, 1893; the preserved specimens are colourless.

SIZE of the larger specimen.—Oral disc 2·5 cm., height 2·5 cm. (the aboral part, however, is strongly contracted); of a smaller specimen: length about 3·2 cm., greatest diameter 1 cm.

OCCURRENCE.—Low Isles, 23.viii.28, 1 specimen; 21.iv.1929, 1 specimen; May 1929, 1 specimen. Futher distribution: Torres Straits, Mer, Great Barrier Reef.

Heteranthus verruculatus Klunz.

Heteranthus verruculatus Klunzinger, 1877, p. 84, pl. v, fig. 9; Carlgren, 1900, p. 92; Stephenson, 1922, p. 290.

I have referred the single specimen with some hesitation to *verruculatus*, though the sphincter (Text-fig. 14) is somewhat stronger than in that species but of about the same

TEXT-FIG. 14.—Sphincter of *Heteranthus verruculatus* Klunzinger.

appearance. It is probably not identical with *H. insignis*, as the nematocysts of the column are considerably longer in that species than in *verruculatus* (33·8–38μ in the former, about 15·5–20μ in the latter; unfortunately I have now no opportunity of examining the nematocysts of *verruculatus* in further detail). The verrucae are arranged in vertical rows; they are large, but smaller at the margin. The marginal tentacles are 96 (12 + 12 + 24 + 48) in number, short and conical, the close-set discal tentacles are papilliform. There are 2 siphonoglyphs and 2 pairs of directives. The retractors of the mesenteries are band-like, on the smaller mesenteries more restricted, the parietobasilar muscles form a distinct fold. As to the arrangement of gonads, I cannot give any information, as they are probably absent. The nematocysts of the tentacles are 14–17 × about 2·2–2·5μ, basitrichs; those of the tentacles 14–19 × 2·5–2·6μ, basitrichs, common; those of the

actinopharynx 20·4–24 × about 3μ, basitrichs; those of the filaments partly 22·6–32·4 × 3·5–4·2μ, partly 10–19·7 × 1·5–2·5μ, both basitrichs, partly 14–22·6 (26·8) × about 4·2μ, microbasic *p*-mastigophors.

SIZE of the preserved specimen.—Length and diameter about 1 cm.

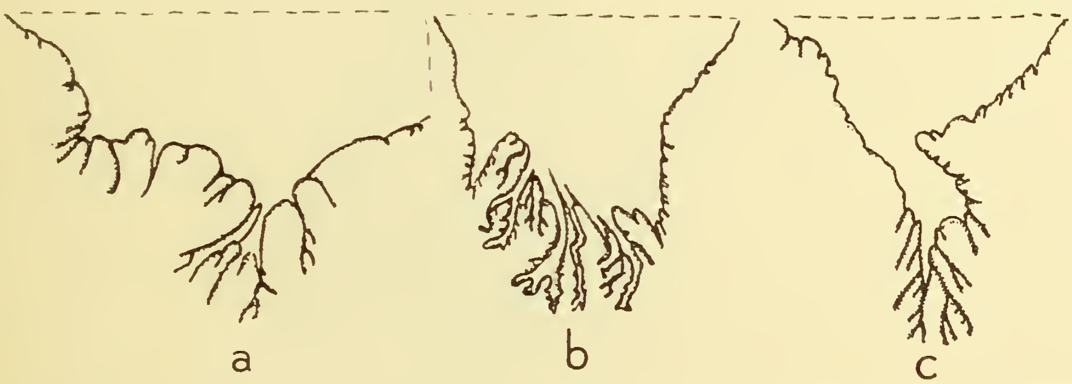
OCCURRENCE.—Low Isles or Snapper Island, 1 specimen, together with *Rhodactis bryoides*.

Fam. THALASSIANTHIDAE.

Heterodactyla Hemprichii Ehr.

Heterodactyla Hemprichii Ehrenberg, 1834, p. 266; Kwietniewski, 1896, p. 601; Haddon, 1898, p. 485; Carlgren, 1900, p. 114 (references); 1945, p. 14.
Thalassianthus Hemprichii Stephenson, 1922, p. 296; Stephenson and others, 1931, p. 47.

I described the anatomy of this species in 1900, and, in 1945 (p. 14), the cnidom of a species of *Heterodactyla* which I believe to be identical with *Hemprichii*. The sphincter is very weak in comparison to the size of the animal, and varies in appearance.



TEXT-FIG. 15.—Sphincters of *Heterodactyla Hemprichii* Ehrenberg. Specimens from (a) Low Isles, (b) Sumatra, and (c) Zanzibar.

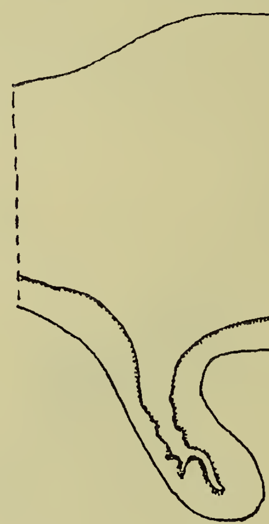
In Text-fig. 15 I have drawn the sphincters of specimens from Low Isles (a), Sumatra (b) and Zanzibar (c). Kwietniewski (1896) mentions that there was no sphincter in *Heterodactyla* from Ceylon. Probably he overlooked it owing to its small size. The nematocysts of the column were, in the specimen from Low Isles, 19·7–21 × about 2·8–3μ, basitrichs; those of the nematospheres 34·5–41 (45·2) × 2·8μ, basitrichs, numerous; those of the inner tentacles 35·2–39·5 × 2·8μ, basitrichs; those of the actinopharynx 27·5–31 × 3μ, basitrichs; those of the filaments partly 28·2–32·4 × 2·8μ, partly 11·3–14 × 1·5–2·2μ, both basitrichs, partly 28·2–31 × 5–5·6μ, microbasic *p*-mastigophors. The sizes of the nematocysts agree rather well with those of a specimen from Sumatra (Carlgren, 1945, p. 14), but those of the inner tentacles are considerably larger in the present specimen; since, however, only traces of their ectoderm remain in the specimen from Sumatra, my information about the sizes of the nematocysts of the tentacles in that specimen is uncertain.

OCCURRENCE.—Low Isles, 1 specimen. Further distribution: Red Sea, Zanzibar, Ceylon ?, Sumatra, tropical coast of Queensland from Torres Straits to Cape Flattery.

Cryptodendron adhaesivum Klunz.

Cryptodendron adhaesivum Klunzinger, 1877, p. 86, Pl. VI, fig. 4 ; Studer, 1878, p. 545 ; Kwietniewski, 1896, p. 600, pl. xxvi, fig. 15 ; Haddon & Shackleton, 1893, p. 117 ; Haddon, 1898, p. 483, pl. xxv, figs. 4–6, pl. xxxiii, figs. 5, 6 ; Stephenson, 1922, p. 296 ; Stephenson and others, 1931, p. 47 ; Carlgren, 1940, p. 32, fig. 9, 13.

Kwietniewski (1896) has given notes on the anatomy of this species, Haddon (1898) figures of the sphincter, and Carlgren (1940) information about the cnidom of a specimen from Billeton. The column of the present specimen and that from Billeton is provided with suckers in its upper part. The sphincter was, in Haddon's and Studer's specimens, rather well developed, though small in comparison with the size of the animal, and of somewhat different structure. The sphincter of the present specimen is very weak and consists only of a thin muscle lamella (Text-fig. 16) projecting from the column, though the corona of the animal is 6 cm. across. Owing to the variable appearance of the sphincter Haddon



TEXT-FIG. 16.—Sphincter of *Cryptodendron adhaesivum* Klunzinger.

suggests that the different specimens described as *adhaesivum* may be different species, but as weak sphincters often vary in appearance there is no reason to keep the individuals apart even though their colour also varies.

The aboral prolongations of the siphonoglyphs are well developed. Three cycles of mesenteries seem to be perfect. The nematocysts of the column of the present specimen are 19·7–22·6 × 2·8μ, basitrichs, numerous ; those of the inner tentacles partly 15·5–29·6 × 2·2–2·5μ, basitrichs, partly 32·4–43·7 × 4·2–5·6μ, microbasic *p*-mastigophors ; those of the nematospheres 29·6–36·7 × 2–2·5 (2·8) μ, basitrichs, numerous ; those of the outer tentacles partly 16·2–26·8 × 2–2·5 (2·8) μ, basitrichs, partly 38–42 × 5·6μ, microgasic *p*-mastigophors ; those of the actinopharynx 25·4–32·4 × 2·8μ, basitrichs (besides a few basitrichs 18·3–19·7 × 2·8μ) ; those of the filaments partly 25·4–29 × (2·5) 3μ, partly 17–19·7 × 2·5μ, few, both basitrichs, partly 31–35·2 × about 5·6μ, microbasic *p*-mastigophors. The nematocysts of this specimen agree well with those of the specimen from Mindanao (Carlgren, 1940), only the basitrichs of the inner tentacles are larger in the present example. It may, however, be noted that the ectoderm of the tentacles of the specimen from Billeton had fallen away to a considerable extent.

Occurrence.—Low Isles, 1 specimen. Further distribution: The Red Sea, Zanzibar, coast of Salvatti, New Guinea, Billeton, Mindanao, Torres Straits, Murray Islands.

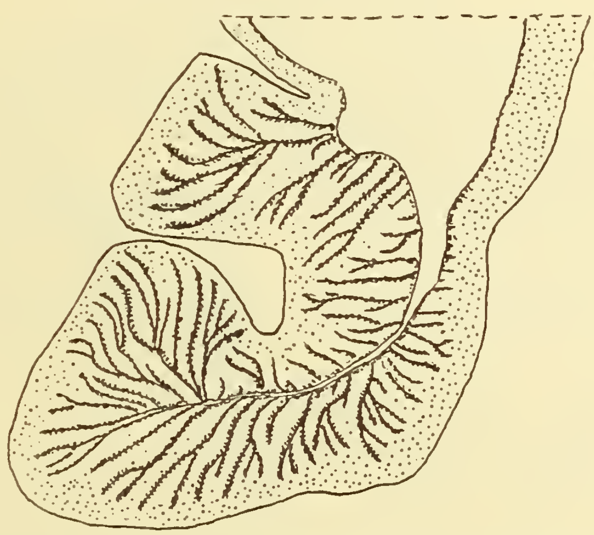
Fam. Stoichactiidae.

Stoichactis kenti (Hadd. & Shackl.).

Discosoma kenti Haddon & Shackleton, 1893, p. 119; Saville-Kent, 1893, p. 144, chromo pl. 1; 1897, p. 219, pl. xxxix B (*D. Haddoni*).

Stoichactis kenti Haddon, 1898, p. 473, pl. ,xxxi figs. 6, 7; Stephenson and others, 1931, pp. 38, 44, 47, 49, 50, 54, 72, pl. x, fig. 1; Stephenson, 1946, pl. vi.

The sphincter of a large specimen agrees very well with that figured by Haddon (1898, plate xxxi, fig. 6, 7). Haddon mentions that the sphincter has a tendency to divide into two branches. In a specimen sectioned by me from Southport, Queensland,



Text-fig. 17.—*Stoichactis kenti* (Haddon and Shackleton). Sphincter of a specimen from Southport, Queensland.

the sphincter was considerably (almost 3 times) stronger and distinctly divided into two branches (Text-fig. 17). The anatomy of this species and the following is very similar, but it seems that *kenti* should have microbasic *p*-mastigophors in the ectoderm of the column while they are absent in *haddoni*. My material of the two species is, however, insufficient to decide the validity of this suggestion. The nematocysts of the column are partly 14·8–18·3 × 2·5–2·8μ, basitrichs, partly 24–25·4 × 4·2–5·6μ, microbasic *p*-mastigophors; those of the tentacles 26·8–33·8 × 2·8–3μ, basitrichs; those of the actinopharynx 25·4–31 × 3·5 (4μ), basitrichs; those of the filaments partly 25·4–28·5 × 3·5μ, basitrichs, partly 29·6–35·2 × 5·6–6·3μ, microbasic *p*-mastigophors.

Colour.—A large specimen painted from life by Stephenson (1946, plate vi) had prussian blue tentacles.

Occurrence.—Low Isles, 2.ix.28, 1 large specimen. Further distribution: from Torres Straits southwards to Mackay; on the Western Australia coasts as far south as Sharks Bay (Haddon); Southport, Queensland.

Stoichactis haddoni (Sav.-Kent).

Discosoma haddoni Saville-Kent, 1893, p. 32, 145, photo pl. xxi, chromo. pl. ii; 1897, p. 221.
Stoichactis haddoni Haddon, 1898, p. 474, pl. xxxi, fig. 8.

The sphincter of the single specimen is much weaker than that of *kenti*, and of similar appearance to that figured by Haddon (1898, plate xxxi, fig. 8). The nematocysts of the column are 12·7–15·5 × (2·2) 2·5μ, basitrichs; those of the tentacles 23·3–32·4 × 2·8–3·5μ, basitrichs; those of the actinopharynx 21·1–28·2 (32·9) × 3–4μ, basitrichs; those of the filaments partly 22·6–29·6 × about 3μ, numerous, partly 12·7–16·9 × about 2·2μ, few, both basitrichs, partly 26·8–32·4 × about 5·6μ. See also under *S. kenti*.

Colour.—Two small specimens were green (Stephenson).

Occurrence.—Low Isles, 22.iii.29, 1 specimen; 2.ix.28, 2 small specimens. Further distribution: about the same as that of *S. kenti*.

Fam. Hormathiidae.

Hormathianthus tuberculatus Carlgr.

Hormathianthus tuberculatus n. sp., Carlgren, 1943, pl. ii, figs. 3–6, text-figs. 23, 24.
? *Hormathia andersoni* n. sp., Haddon, 1888, p. 125, pl. xx.
? *Chitonanthus andersoni* Hadd., Haddon, 1898, p. 460.

The specimen agrees with the type, but the basitrichs of the acontia are here somewhat larger, 31–35 × 3–3·5μ.

Occurrence.—Penguin Channel, 14 fms., 1 specimen. Further distribution: Bay of Nhatrang, S. Annam, Ream, Cambodja, Paulo Condore, ? Mergui Archipelago.

Calliactis miriam (Hadd, & Shackl.).

Adamsia miriam n. sp., Haddon and Shackleton, 1893, p. 130.
Calliactis miriam (H. & S.), Haddon, 1898, p. 457, pl. xxiii, fig. 25; Stephenson and others, 1931, p. 72.

Haddon and Shackleton described the external features of this species in 1893. The sphincter is strong, distinctly stratified transversely, about the same in appearance as the sphincter of *C. polypus* (Carlgren, 1928, p. 198, Text-fig. 37). The tentacles of the largest specimen are about 300 or more, and very closely set. The longitudinal muscles of the tentacles and radial muscles of the oral disc are ectodermal. There are 2 siphonoglyphs and two pairs of directives. Six pairs of mesenteries are perfect and sterile, the imperfect ones are fertile. The muscles of the mesenteries are weak. The nematocysts of the column are 5·6–7 × 1·5–2·5μ, basitrichs; those of the tentacles 17·7–25·4 × 2·2–2·5μ, numerous, basitrichs; those of the actinopharynx 16·2–21·1 × 2·5–2·8μ, basitrichs; those of the filaments partly 17–21 × about 4·2μ, microbasic *p*-mastigophors, partly 9·2–11·3 × 2·8μ basitrichs; those of the acontia 17–22·6 × 2·8–3μ, basitrichs. These nematocysts were measured from a specimen from the Great Barrier Reef; those of the tentacles and acontia also from an individual from Low Isles.

Colour in the preserved condition.—On some specimens there are traces of the patches which are present in the type. The patches are here greenish grey. Traces of banding on some of the tentacles are visible.

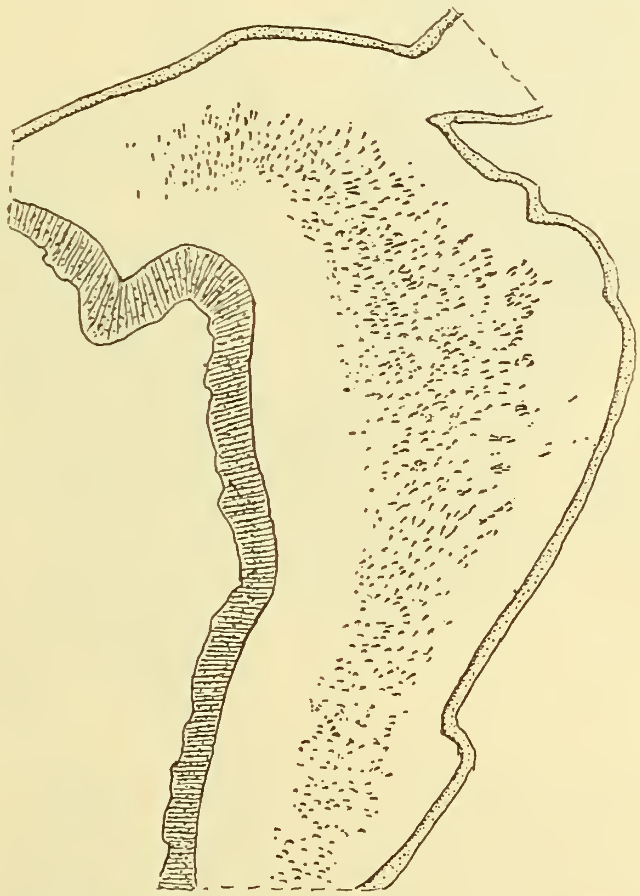
Size of the largest specimen in the preserved condition.—Height 2 cm., diameter of the very extended pedal disc 3·5 × 2·5 cm.

Occurrence.—Probably Low Isles, on shell of *Dolium*, with hermit, 4 specimens. Outer Barrier Reef, 4.vi.29, 2 specimens on shell of conch with hermit. Further distribution: Torres Straits, Mer.

Fam. Isophellidae.

Telmatactis stephensoni n. sp.

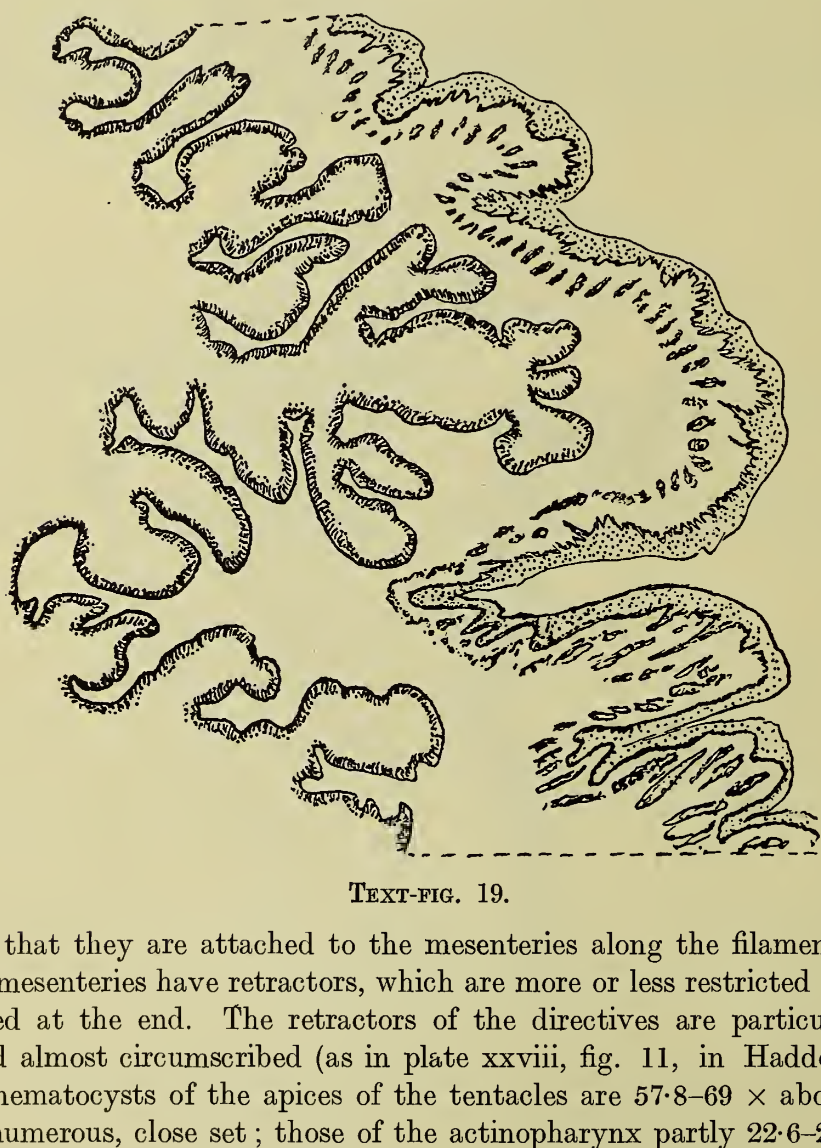
Column divisible into a long scapus and a short scapulus, the former with a cuticle. Sphincter very long, alveolar, with small meshes, broad in its upper part, where it is set in the middle of the mesogloea, diminishing downwards and here approaching the endo-



Text-fig. 18.—Upper part of sphincter of *Telmatactis stephensoni* n. sp.

derm, but always wholly separated from the endodermal muscles of the column. The lower part of the sphincter recalls in its appearance that of *Telmatactis* (*Phellia*) *vermiformis* (see plate xxvii, fig. 10, in Haddon's paper of 1898). Tentacles, 74, arranged (according to Stephenson) 6 + 6 + 12 + 24 + 26, those of the fifth cycle developed only between those of the second and third cycles, except that in one section there were two additional tentacles, making 26 in the fifth cycle altogether, instead of the theoretical 24. Apices of the tentacles knobbed and, in the preserved condition, longitudinally furrowed.

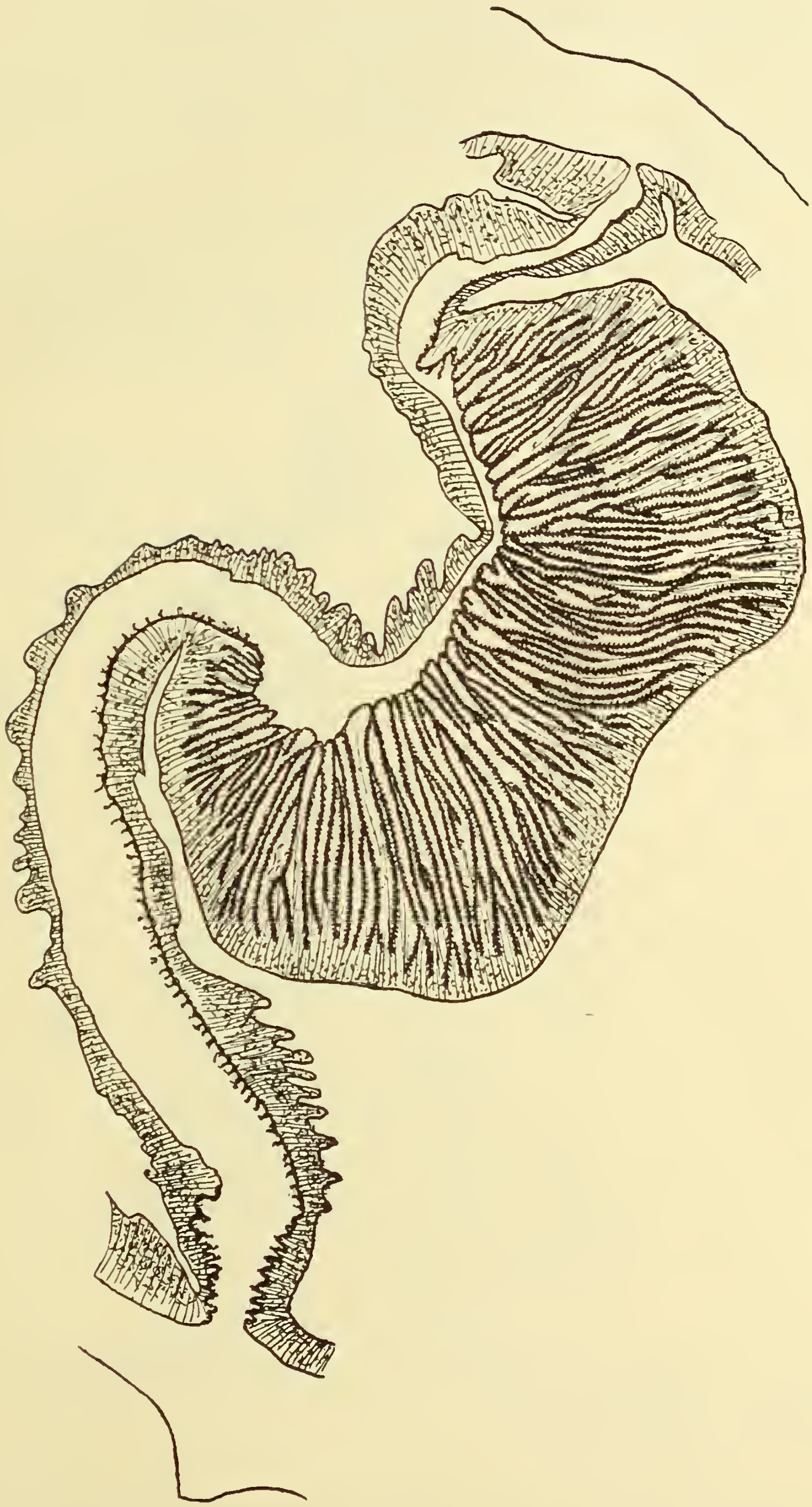
Actinopharynx ridged, with two siphonoglyphs, which are not strongly marked. Pairs of mesenteries, 37 (6 + 6 + 12 + 13) corresponding to the arrangement of the tentacles, so that the mesenteries of the fourth cycle are lacking on either side of those of the first cycle, except in one sector, where they are present. The mesenteries of the fourth cycle are provided, at least in some cases, with a short filament. Only the mesenteries of the first cycle are perfect and fertile, those of the first to third cycles are provided with filaments and acontia. Whether the acontia show an arrangement similar to that found in *T. panamensis* is difficult to decide, as they are very numerous and plaited together; but



Text-fig. 19.

it is possible that they are attached to the mesenteries along the filaments. Only the first cycle of mesenteries have retractors, which are more or less restricted and form high folds branched at the end. The retractors of the directives are particularly strongly restricted and almost circumscribed (as in plate xxviii, fig. 11, in Haddon's paper of 1898). The nematocysts of the apices of the tentacles are 57·8–69 × about 2·8μ, basitrichs, very numerous, close set; those of the actinopharynx partly 22·6–26·8 × 4·2–5μ, microbasic *p*-mastigophors, partly 26·8–31 × about 2·8μ, basitrichs, partly 43·7–48 × 7–8·5μ, probably microbasic amastigophors, perhaps not belonging to the actinopharynx; those of the filaments partly 14·1–16·9 × 3·5–4·2μ, microbasic *p*-mastigophors, partly 11·3–14·8 × about 1·5–2μ, basitrichs; those of the acontia partly 50–56·4 × about 10μ, microbasic amastigophors, partly 21·1–24 × 2·5–2·8μ.

Colour.—Knobs of tentacles yellowish red, their shafts banded; disc and tentacles with a remarkably complex, bilaterally symmetrical pattern, the directive axis also being



Text-fig. 20.

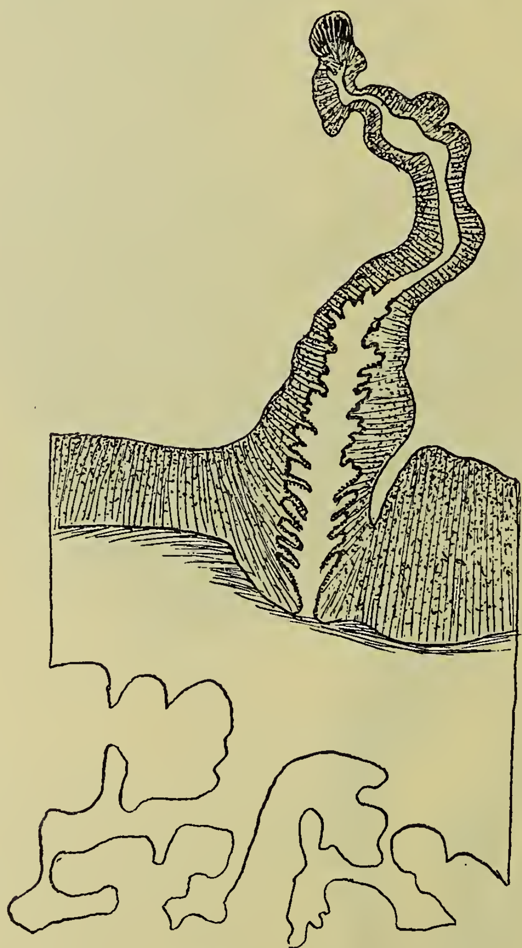
indicated by special markings. A coloured figure of the disc and tentacles, accompanied by explanatory diagrams, is given by Stephenson (1947, plate iv).

Size of the very contracted specimen.—Length 2·8 cm., diameter 2·5 cm.

Occurrence.—Low Isles, from the interstices of branching coral, 1 specimen. In Text-fig. 18 I have drawn the upper part of sphincter. The species recalls *T. vermiformis*, but the colour is quite different.

Telmatactis australiensis n. sp.

Column as in the preceding species. Tentacles 50, hexamerously arranged, 6 + 6 + 12 + 24 + 2, tips longitudinally sulcated, probably knobbed, shafts transversely folded. Sphincter recalling that of *T. stephensoni* but not so long, in the lower part not so sharply separated from the endodermal muscles of the column (Text-fig. 19). Pairs of mesenteries



Text-fig. 21.

Text-figs. 19–21—*Telmatactis australiensis* n. sp. 19. Lower part of sphincter. 20. Transverse section of mesentery of first cycle at level of lower part of actinopharynx. 21. Mesentery of second cycle.

6 + 6 + 12 (+ 1, probably in the uppermost part of the column, where there are 3 small, close-set tentacles). Only the first cycle are perfect and provided with strong, very restricted, almost kidney-like retractors (Text-fig. 20; transverse section of a mesentery of the first cycle at the level of the lower part of the actinopharynx). The mesenteries

of the second cycle have filaments and longitudinal muscles on both sides of the mesenteries (Text-fig. 21). The nematocysts of the tips of the tentacles are partly 55–65 × 2·5–2·8μ, basitrichs, numerous, very close set, partly 32·4–36·7 × about 4·2μ, microbasic *p*-mastigophors ? ; those of the actinopharynx partly 26·8–33 × about 2·8μ, basitrichs, partly 39·5–49·3 × about 7·7μ, probably microbasic amastigophors ; those of the filaments partly 14–15·5 × 3·5–4·2μ, microbasic *p*-mastigophors, partly 12·7–15·5 × about 1·5, basitrichs, few ; those of the acontia partly 45–56·5 × 8·5–10 (11·3)μ, microbasic amastigophors, partly 19·7–24 × 2·2μ, basitrichs.

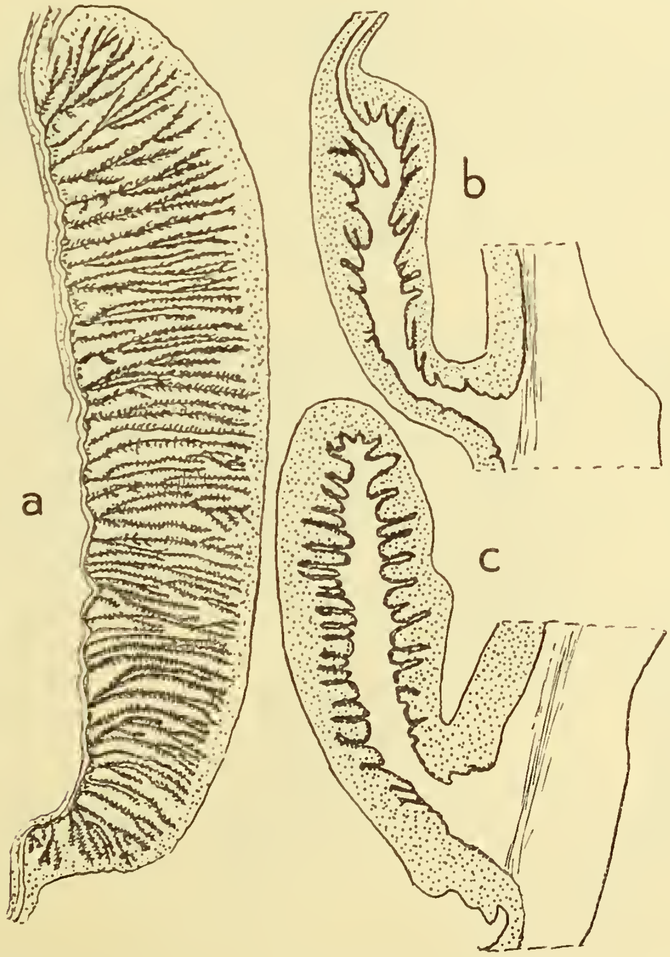
Colour.—Unknown.

Size.—Length 1·3 cm., breadth 1·1 cm. (Body very contracted.)

Occurrence.—Three Isles, anchorage, 4.v.29, 1 specimen.

Telmatactis insignis n. sp.

Column divisible into scapus and scapulus, the former provided with a thin cuticle. Sphincter very long, reticular in its uppermost part ; lower down it consists of only a few meshes, and in its lower part it increases considerably in thickness and is situated near



Text-fig. 22.—*Telmatactis insignis* n. sp. (a) Retractor in the region of the actinopharynx. (b) Parietal part of perfect mesentery immediately below the actinopharynx. (c) Mesentery of the second cycle from the same region as (b).

the endoderm. (A section of the sphincter in the lower part recalls that of *T.* (*Phellia*) *vermiformis* (Haddon).) The tentacles are 48 in number, short, indistinctly sulcated at their distal ends, but not knobbed; their longitudinal muscles are ectodermal and well developed. The actinopharynx has high longitudinal folds. There are 2 siphonoglyphs and 24 pairs of mesenteries (6 + 6 + 12 pairs). Only the mesenteries of the first cycle are perfect, but at least those of the second cycle are provided with filaments and acontia. The retractors are diffuse but somewhat restricted below the actinopharynx, forming high, close-set and branched folds. The parietal muscles are weak, as also are the muscles of the mesenteries of the second and even more those of the third cycles. The single specimen is sterile. The nematocysts of the tentacles are partly 46·5–51 × 2·5–2·8μ, basitrichs, very numerous, partly 28·2 × 5μ, probably microbasic amastigophors, very rare; those of the actinopharynx partly 22·6–28 × 2·8μ, partly 13–14 × 1·5μ, both basitrichs, partly 22·6–28·2 × 4·2–5μ, microbasic *p*-mastigophors, partly 33·8–43·7 × 6·3–8·5μ, probably microbasic amastigophors; those of the filaments partly 11·3–14 × (3·5) 4·2μ (·24 × 5μ), microbasic *p*-mastigophors, partly 11·3–14 × 1·5–2μ, basitrichs; those of the acontia partly 47·2–57·8 × 10–11·3 (12·7) μ, microbasic amastigophors, partly 19·7–23·4 × about 2·5μ, basitrichs.

Size.—Length 2 cm., breadth 1 cm.

Occurrence.—Low Isles, 18.viii.28, 1 specimen.

I have drawn figures of a retractor (Text-fig. 22a) in the region of the actinopharynx, of the parietal part of a perfect mesentery (Text-fig. 22b) and of a mesentery of the second cycle (Text-fig. 22c), both the latter sections taken immediately below the actinopharynx.

Genus *Epiphellia*.

Epiphellia n. gen., Carlgren, 1949, p. 89.

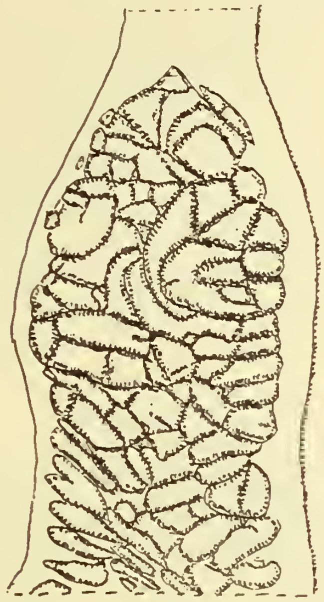
Isophelliidae with small base. Column elongate, divisible into scapus and scapulus, the former with tenaculi, probably without cinclides. Sphincter mesogloeal, elongate, usually strong. Longitudinal muscles of tentacles and radial muscles of oral disc ectodermal. Two distinct siphonoglyphs and two pairs of directives. No more mesenteries distally than proximally. Six pairs of macrocnemes, microcnemes recalling the parietal part of the macrocnemes. Retractors of the macrocnemes strongly restricted to circumscribed, very strong. Parietal muscles of the microcnemes, which may be provided with filaments and acontia, strong. Cnidom: spirocysts, basitrichs, microbasic *p*-mastigophors, microbasic amastigophors.

Genotype.—*E. anneae* sp. n.

E. anneae n. sp.

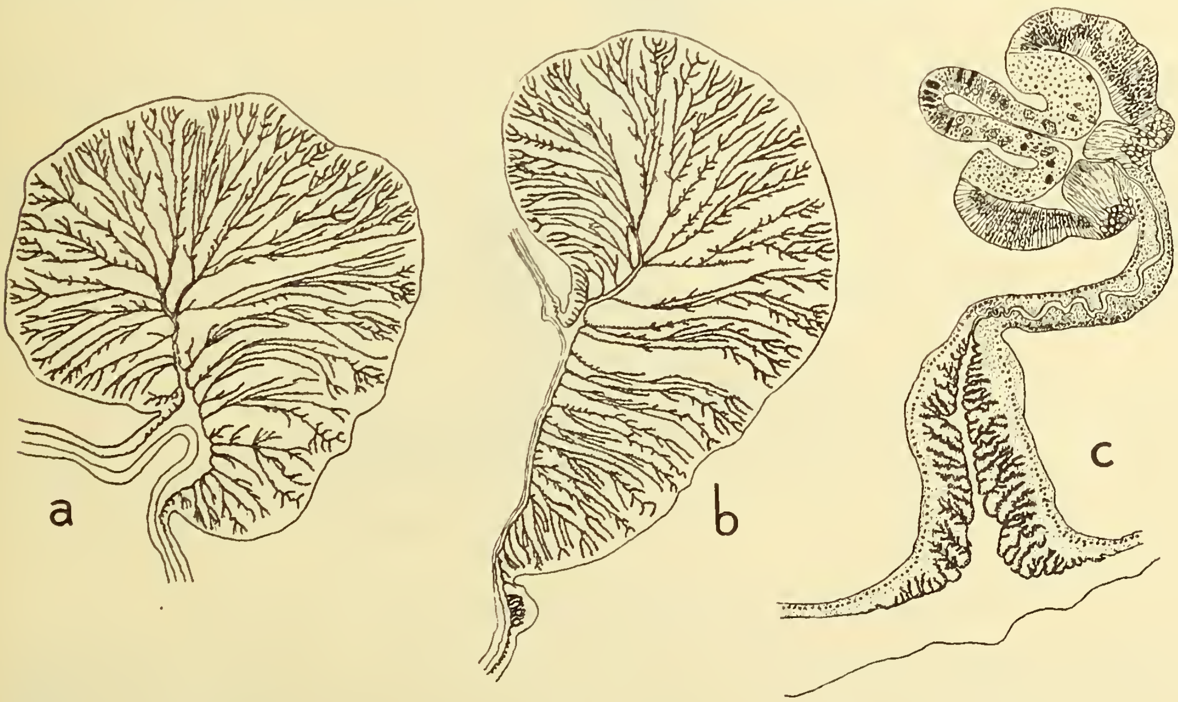
Pedal disc small. Column divisible into a long scapus and a short scapulus. Scapus provided with tenaculi to which grains of sand may be attached. Sphincter long, reticular in its upper part, alveolar in its lower. Tentacles 48 (6 + 6 + 12 + 24), not knobbed at their tips, their longitudinal muscles ectodermal. Actinopharynx ridged. Two distinct siphonoglyphs and two pairs of directives. Six pairs of macrocnemes, the "*Edwardsia*" mesenteries stronger than the other macrocnemes in the sense that they are considerably longer. The retractors of the macrocnemes are very strong and more or less circumscribed, forming very fine and long branched folds. The 18 pairs of microcnemes lack retractors

but their muscles are well developed, elongate and branched, and recall the parietal muscles of the macrocnemes. All mesenteries have filaments and acontia. The nemato-



Text-fig. 23.—Uppermost part of sphincter of *Epiphellia anneae* n. sp.

cysts of the column are 14–21 × 2·8μ, basitrichs ; those of the tentacles partly 14–16·2 × 2·8μ, partly 26·8–38·8 × about 2·8μ, both basitrichs ; those of the actinopharynx partly 12·7–15·5 × 1·5μ, partly 25·4–35·2 × 2·8μ, both basitrichs, partly 28·2–31 × 3·5–4μ,



Text-fig. 24.—*Epiphellia anneae* n. sp. (a) Cross section of rectractor muscle of a directive mesentery. (b) Cross section of retractor muscle of a non-directive mesentery. (c) Section of mesentery of the third cycle.

microbasic p-mastigophors, partly $43{\cdot}7$–$50{\cdot}8 \times 7$–9μ, common, probably microbasic amastigophors; those of the filaments $16{\cdot}9$–$19{\cdot}7 \times 3{\cdot}5$–$4{\cdot}2\mu$, microbasic p-mastigophors; those of the actonia partly $53{\cdot}6$–65×7–8μ, common, microbasic amastigophors, partly 19–$25{\cdot}4 \times 2{\cdot}5$–$2{\cdot}8\mu$, common, basitrichs.

Size of the single specimen.—Length about 6·5 cm., greatest diameter about 1 cm.

Occurrence.—Low Isles, 2.ix.28, 1 specimen.

The sphincter is elongate and extends some distance into the scapus. It is broad and reticular in its uppermost part (Text-fig. 23), but diminishes downwards where it forms a thin streak near the ectoderm; still further down it approaches the endoderm and at the same time becomes somewhat broader. The folds of the retractors are very delicate. In Text-fig. 24 I have drawn cross-sections of two retractors, (a) from a directive mesentery and (b) from a non-directive. The figure also (c) shows a section of a mesentery of the third cycle.

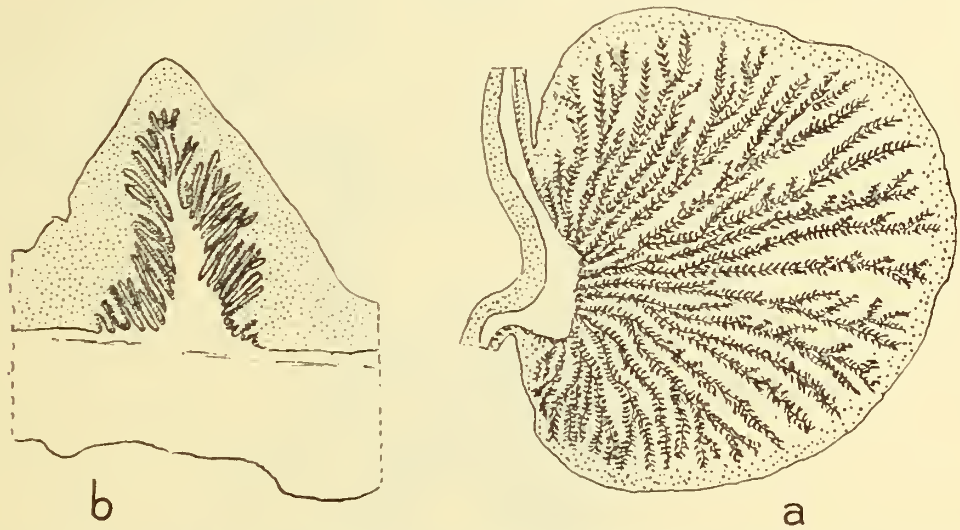
E. elongata n. sp.

Pedal disc small. Column elongate, divisible into scapus and scapulus, the former provided with tenaculi. Sphincter mesogloeal, reticular in its uppermost part, alveolar in its lower part, forming a thin streak near the ectoderm; considerably shorter than

Text-fig. 25.—Uppermost part of sphincter of *Epiphellia elongata* n. sp.

that of *E. anneae* but extending a little way into the scapus. Tentacles of the larger specimen about 30 in number, rather short; longitudinal muscles of tentacles and radial muscles of oral disc ectodermal. Actinopharynx long, with 2 distinct siphonoglyphs. Six pairs of macrocnemes, 2 pairs of which are directives; six pairs of microcnemes belong-

ing to the second cycle. The third cycle is represented only by 4 pairs of microcnemes and two single (unpaired) microcnemes; the four pairs are situated in the lateral and dorso-lateral primary exocoels ventral to second-cycle pairs; the two single mesenteries occupy a similar position in the ventro-lateral exocoels. The "*Edwardsia*" macrocnemes have longer filaments and are somewhat stronger than the other macrocnemes. The retractors of the macrocnemes are circumscribed and richly branched, the parietal muscles form high and somewhat branched folds. The mesenteries of the second cycle have exceptionally small filaments and acontia. The nematocysts of the tentacles are 26·8–35·2 × 2·2–2·8μ, very common, basitrichs; those of the actinopharynx partly 24·7–28·2 × 2·8μ, partly about 11 × 1·4μ, very rare, both basitrichs, partly 28·2–31 × 5–5·6μ, microbasic *p*-mastigophors; those of the filaments partly 15·5–18·3 × 3·5–4μ, microbasic



TEXT-FIG. 26.—*Epiphellia elongata* n. sp. (a) Cross section of retractor muscle. (b) Cross section of mesentery of the second cycle.

p-mastigophors, partly about 8·5 × 1·4μ, very rare, basitrichs; those of the acontia partly 45–56·4 (65) × 7·8–9·2μ, microbasic amastigophors, partly 15·5–19·7 × 2·2–2·5μ, basitrichs.

SIZE of larger specimen.—Length about 3 cm., greatest diameter about 0·6 cm.; of the smaller specimen: length 1·3 cm., diameter up to 0·4 cm.

OCCURRENCE.—Low Isles, 10.iv.29, 2 specimens.

The scapus is provided with a thin cuticle, considerably thickened on the tenaculi. Text-fig. 25 shows a section of the uppermost part of the sphincter, Text-fig. 26 a section of a retractor, and Text-fig. 26b a section of a mesentery of the second cycle. The specimen examined is a male.

Fam. SAGARTIIDAE.

Anthothoë australiensis n. sp.

The pedal disc is very extensive, on a shell with hermit. The column is smooth, the sphincter very strong, reticular and separated from the endodermal muscles of the column by a very thin strip of mesogloea. In Text-fig. 27 I have drawn the sphincter (only a part of the reticulum is figured, but the inner line shows the distribution of the sphincter).

The tentacles are moderately long and numerous. I counted 130 in one half of a specimen. The longitudinal muscles of the tentacles are ectodermal. There are 2 well-developed siphonoglyphs, regularly placed, in the one individual; in the other one only. The gonidial tubercles are well developed. The actinopharynx has 20–22 longitudinal ridges. There are two directive pairs or only one. In the typical specimen 12 perfect and sterile mesenteries are present, the mesenteries of the third and fourth cycles are provided with testes. The retractors are diffuse and very weak. The mesenteries at the margin are

TEXT-FIG. 27.—Sphincter of *Anthothoë australiensis* n. sp.

seemingly more numerous than at the base. The nematocysts of the column are partly 12–17 × 2·2–2·8μ, basitrichs, partly 17·6–21 × 4μ, often a little curved, probably basitrichs; those of the tentacles partly 32·4–36·7 × about 3μ, common, partly 14·8–17 × 1·5–2·2μ, rather common, both basitrichs; those of the actinopharynx partly 17–22·6 × 2–2·5μ, basitrichs, partly 31–36·7 (42) × 4·5 (5·6) μ, microbasic *p*-mastigophors, those of the filaments partly 8·5 × 1·5μ, few, partly 7·8–10 × 2·8–3μ, common, fusiform, microbasic *p*-mastigophors, partly 26·8–31 × 4·2–5·6μ, common, microbasic amastigophors ?, those of the acontia partly 56·4–65 × 7–7·5μ (67·7–77·6 × 8·5μ, probably development stages), microbasic amastigophors, partly 11·3–14·1 × 2·2–2·5μ, basitrichs.

SIZE of largest specimen.—Height 1·2 cm., diameter of the very wide pedal disc 4·5 × 3·5 cm.

OCCURRENCE.—Batt Reef, 2.viii.28, 2 specimens on shell with hermit.

It is possible that the species is identical with *Sagartia Milmanni* (Hadd. & Shackl.) described by Haddon, 1898, p. 449, but as there are no notes about the colour of the present species, and the types and size of the nematocysts in *Milmanni* are unknown, I have preferred to erect a new species for it.

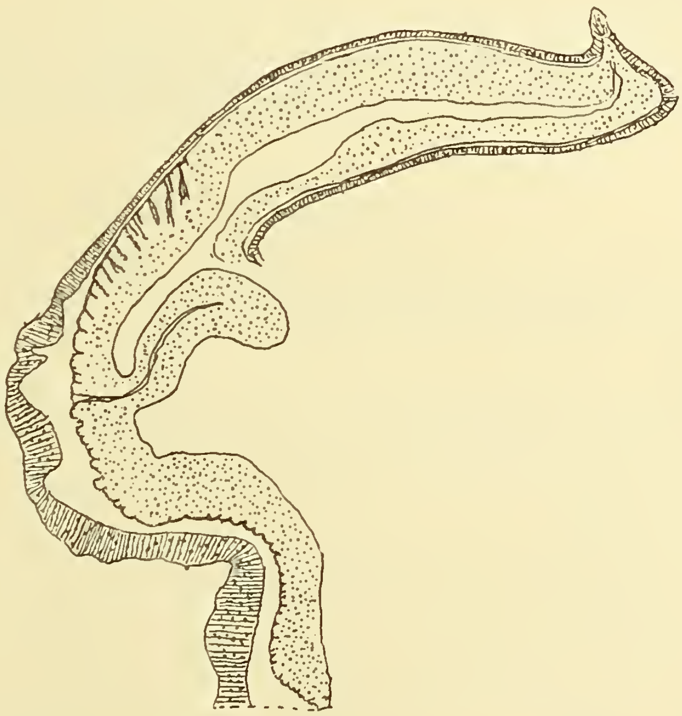
CORALLIMORPHARIA.

Fam. RHODACTIIDAE.

Rhodactis Howesii Sav.-Kent.

Rhodactis Howesii Saville-Kent, 1893, p. 150, chromo. pl. iii, fig. 2, a–c ; Haddon, 1898, p. 478.

I have identified the single specimen with *Rhodactis Howesii.* The marginal tentacles are well developed. Round about the mouth there are some simple or little branched tentacles. The other discal tentacles are branched, and in the inner part of the oral



TEXT-FIG. 28.—Sphincter of *Rhodactis Howesii* Sav.-Kent.

disc they are sparsely set, in the other parts closely arranged and richly branched. The number of branches varies, but many tentacles have up to about 20 branches. Near the margin there is a more or less naked zone as in *R. indosinensis.* The sphincter (Text-fig. 28) is somewhat weaker than that of the latter species. The nematocysts of the column are partly 22·6–25·4 × 9·2–10μ, microbasic *p*-mastigophors, partly 18·3–21 × 5·6–7μ, microbasic *b*-mastigophors, partly 35·2–42·3 × 11·3–15·5μ, holotrichs ; those of the marginal

tentacles partly 22–35 × 4·2–5·6μ, atrichs, rare, partly 21–26·8 × 5·6–8·5μ, microbasic *p*-mastigophors, partly 15·5–19·7 × 4·2–5·6μ, microbasic *b*-mastigophors, partly 35·2–42·3 × 15·3–17μ, partly 91·6–105·7 × 42·3–48μ, both holotrichs, in the endoderm; those of the discal tentacles 22·6–24 × about 7μ, few, microbasic *p*-mastigophors; those of the actinopharynx 36·7–42·3 × 14–17μ, holotrichs; those of the filaments partly 35·2–42·3 × about 8·5–9·2μ, microbasic *p*-mastigophors, partly 159–177 × 53·6–56μ, partly 35·2–36·7 × 15·5–17μ, both holotrichs.

Colour.—See Saville-Kent. The preserved specimen is brownish.

Size in the contracted condition.—Height 1·2 cm., diameter of pedal disc 4 × 2 cm., that of oral disc 3 × 2·2 cm.

Occurrence.—Low Isles, western moat, 1 specimen; Cleveland Bay, near Townsville, Queensland (Saville-Kent).

Rhodactis bryoides Hadd. & Shackl.

Rhodactis bryoides n. sp., Haddon and Shackleton, 1893, p. 121; Carlgren, 1943, p. 16, fig. 8a.
Actinotryx bryoides (Hadd. & Shackl.), Haddon, 1898, p. 479, pl. xxv, figs. 1–3, pl. xxxii, figs. 7–9; Stephenson, 1922, p. 306.

Occurrence.—Low Isles or Snapper Island, several specimens. Further distribution: S. Annam, Bay of Nhatrang, Paulo Condore, Torres Straits, Murray Islands.

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1928–29

SCIENTIFIC REPORTS

VOLUME V. No. 8

CHAETOGNATHA

BY

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WITH SIX TEXT-FIGURES

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WITH SIX TEXT-FIGURES

THE material examined consisted of samples of the Chaetognatha taken during the Great Barrier Reef Expedition from nearly 70 stations. The majority of the samples were from townettings taken weekly at a fixed position inside the reef. This position is referred to as 3 mi. E., being 3 miles east of the Laboratory on Low Island. The townettings were taken through a complete year from July, 1928, to July, 1929. The types of net used were one-metre stramin having 16 strands to the inch, coarse silk with 58 strands to the inch, and fine silk with 200 strands to the inch. The hauls were principally oblique, and details of the method used together with further information as to the conditions under which each haul was made are given in Vol. II, No. 2 of this series of reports. The depth at the station 3 mi. E. was about 32 metres, and the maximum depth fished at this station varied from about 19 to 26 metres, the average being about 22 metres. Each haul was of 30 minutes' duration.

The total number of Chaetognatha captured at this station was considerable. The number examined in the samples was over 6000. The station numbers for catches of Chaetognatha made at the 3 mi. E. position were as follows: 2, 3, 5, 6, 7, 9, 10, 12–15, 17, 18, 22–25, 27, 30, 30*a*, 31–42, 47, 48, 51–61, 63, 66, 67.

Some hauls were also made at stations in channels running through the reef, and a few just beyond the edge of the reef and in deeper water outside the reef.

Particulars of these stations at which Chaetognatha were captured are given on next page.

Chaetognatha were also captured at two additional stations: Station 1, 2 mi. N.E. on 27th July, 1928, where oblique hauls were made and the depth was 31 m., the net touching the bottom; Station 4 on 7th Aug., 1928, 1 mi. N., depth 15 m., horizontal hauls being made at the surface (3·5 m. average depth of hauls).

Finally, one haul from which a sample of Chaetognatha was received was made at the Anchorage, Low Is., on 19th Sept., 1928, and two night hauls, one at the foregoing station on 1st Oct., 1928, and one at Station 21, 3 mi. E. on 22nd Oct., 1928. Chaetognatha were also received from one station (16, 3 mi. E.) at which horizontal hauls were made with a closing net at the surface and at five different depths as a test of depth distribution. In all just over 9200 specimens were examined in the present collection.

The species present were the following:

Sagitta bedoti Béraneck.
,, *bipunctata* Q. and G.
,, *enflata* Grassi.
,, *hexaptera* Orb.
,, *lyra* Krohn.
,, *neglecta* Aida.

Sagitta pulchra Donc.
,, *regularis* Aida.
,, *robusta* Donc.
,, *serratodentata* Krohn.

Krohnitta subtilis Grassi.
Pterosagitta draco Krohn.

Station number.	Date.	Position.	Depth in metres.	Max. depth* fished by net in metres.
8	24th Aug., 1928	16° 30′ S. 145° 52′ E. (In Trinity Opening)	45	28·5
11	6th Sept., 1928	16° 24′ S. 145° 52′ E. (In Trinity Opening)	61	34·5
19	20th Oct., 1928	16° 20′ S. 146° 3′ E. (Outside Trinity Opening)	225	Approx. 180
20	,, ,,	16° 19′ S. 146° 7′ E. (Outside Trinity Opening)	>600	Approx. 250
26	19th Nov., 1928	16° 24′ S. 145° 53½′ E. (In Trinity Opening)	57	34
28	23rd Nov., 1928	16° 19′ S. 146° 5′ E. (Outside Trinity Opening)	>600	Approx. 580
29	24th Nov., 1928	16° 17′ S. 146° 2′ E. (Outside Trinity Opening)	*ca.* 200	bottom
43	26th Feb., 1929	15° 16′ S. 144° 26½′ E. (Off Cape Bedford)	30	24
44	27th Feb., 1929	14° 44′ S. 145° 27½′ E. (Off Lizard Island)	31	23·5
45	28th Feb., 1929	14° 31′ S. 145° 35′ E. (Outside Cook's Passage)	>600	Approx. 500
46	,, ,,	14° 32′ S. 145° 32′ E. (Inside Cook's Passage)	33	23
49	17th Mar., 1929	15° 47′ S. 145° 47′ E. (Inside Papuan Pass)	46	31
50	18th Mar., 1929	Outside Papuan Pass	>400	Approx. 400

There have been reports on three principal collections of Chaetognatha from coastal waters of eastern Australia, viz. Ritter-Záhony (1909) from the Gazelle Expedition, Johnston and Taylor (1919) and Tokioka (1940). The species recorded in these reports are *Sagitta ai, S. australis, S. bipunctata, S. enflata, S. hexaptera, S. lyra, S. minima, S. neglecta, S. planctonis, S. pulchra, S. regularis, S. robusta, S. serratodentata, S. tenuis, Krohnitta subtilis, Pterosagitta draco* and *Spadella moretonensis*. Of these *S. australis* is a synonym for *S. enflata*, which leaves 16 species as having been recorded. It will be seen from the previous list that 11 of these are represented in the present collection, though some were present only in small numbers. *S. bedoti* appears to be new to the eastern Australian water, though Tokioka (1940) has reported that it is a common species in the north Pacific and it has been reported from Sharks Bay by Ritter-Záhony (1910), on the west coast of Australia.

The various species differed very much in the frequency with which they occurred and in the number captured. The commonest forms were *S. enflata, S. neglecta* and *S. robusta*, and of these *S. enflata* was found in every haul taken by the expedition from which

* Where the maximum depth fished at a station is given as approximate the haul was vertical, and the figure given is that of the maximum length of wire out. The actual maximum depth fished will therefore be somewhat less than these figures.

Chaetognatha were received. *S. neglecta* and *S. robusta* were taken very frequently, but the numbers were much smaller than those of *S. enflata*. Of the remaining species, *S. bedoti*, *S. pulchra* and *S. serratodentata* come next in abundance, and the remainder were captured only in very small numbers. The actual numbers of individuals of the various species received are given in the systematic part of this report and the distribution is dealt with in a separate section.

SECTION I. SYSTEMATIC.

Sagitta bedoti Béraneck.

Béraneck, 1895–96 ; Ritter-Záhony, 1911 ; Burfield and Harvey, 1926 ; Burfield, 1930 ; Tokioka, 1939.

458 individuals.*

This species is especially difficult to identify when immature, and can easily be mistaken for several others, *e. g.*, *neglecta*. The shorter overall length of the latter species when mature is helpful, but the nature of the seminal vesicle (Tokioka, 1939) is very similar in both species, and the rayless region of the lateral fins in *bedoti* can only be seen in well-preserved and uncrushed specimens. The positive character of the large number of posterior teeth in *bedoti* is useful when they can be clearly counted, but even here there is an overlap between the range of number in *bedoti* and in *neglecta*.

The occurrence of this species in the present collection is notable and is dealt with in the second section of this report.

Formulae. :†

14 — 12	28 — 23	6 (7)	7 — 11	16 — 31
11 — 8	29 — 25	6 (7)	7 — 12	15 — 30

Sagitta bipunctata Q. and G.

Quoy and Gaimard, 1827 ; Burfield and Harvey, 1926 ; Burfield, 1930 ; Johnston and Taylor, 1919 ; Tokioka, 1939 and 1940.

91 individuals.

None of these was fully mature and identification was difficult in consequence. So far as could be judged they conformed to the usual description of the species.

Formulae. :

10 — 9	28 — 27	9	6 — 7	12 — 14
9 — 6	27 — 23	8 (9)	5 (6)	10 — 13
6 — 4	27 — 25	8	4 (5)	10 (11)

* The numbers of individuals given in the Systematic section of this report refer to the numbers of specimens in the samples received for examination.

† The tables of formulae given for each species follow the usual arrangement. The first column gives the length of the specimens in millimetres (without tail fin) ; the second the proportional length of the tail expressed as a percentage of the total length ; the remaining three columns give the number of jaws, the number of anterior teeth, and the number of posterior teeth respectively.

Sagitta enflata Grassi.

Grassi, 1883; Burfield and Harvey, 1926; Burfield, 1930; Tokioka, 1939 and 1940.

6203 individuals.

The most abundant of all the species captured. A number of mature individuals, though none reached the maximum size described for this species. This is one of the most characteristic of the warm water species, and there is no doubt as to its identity. The short ovaries and concentrated testes seen through the transparent body are notable features. In some specimens the testes appeared to be mature with fully developed seminal vesicles, but the ovaries were not fully developed. This may indicate the possibility of the species being protandrous.

Formulae.:

20·5 — 17	18 — 16	8 (9)	8 — 10	13 — 15
17 — 13	20 — 18	9	7 — 10	10 — 16
12 — 10·5	21 — 17	8 (9)	6 — 9	9 — 14

Sagitta hexaptera Orb.

D'Orbigny, 1836; Johnston and Taylor, 1921; Burfield and Harvey, 1926; Burfield, 1930; Bollman, 1934; Fraser, 1937; Tokioka, 1939 and 1940.

13 individuals.

The few captured of this species were nearly all obtained further out than at the principal station inside the reef. They were all immature except one of 26·5 mm. length which was apparently approaching maturity.

Formulae.

26·5 — 10	25 — 23	7 — 10	1 — 3	2 — 4
10 — 7	24 — 22	6 — 9	1 — 3	2 (3)

Sagitta lyra Krohn.

Krohn, 1853; Johnston and Taylor, 1921; Burfield and Harvey, 1926; Burfield, 1930; Tokioka, 1939 and 1940.

31 individuals.

The majority of these were captured at stations inside the reef. None of the specimens was mature and the longest measured 18·0 mm. This species has been recorded up to 38 mm.

Formulae.:

18 — 11	18 — 14	8 (9)	4 — 6	7 — 9
11 — 8	17 — 15	8	4 (5)	7 — 9

Sagitta neglecta Aida.

Aida, 1897 ; Johnston and Taylor, 1919, 1921 ; Burfield and Harvey, 1926 ; John, 1933 ; Tokioka, 1939.

644 individuals.

This species was second in abundance in this collection. The difficulties of identification are mentioned above under *S. bedoti.* A few individuals were mature.

Formulae. :

10 — 8	29 — 28	6 (7)	5 — 7	11 — 17
8 — 5	30 — 28	6 (7)	5 — 7	10 — 16

Sagitta pulchra Doncaster.

Doncaster, 1903 ; Johnston and Taylor, 1919 ; Burfield and Harvey, 1926 ; Tokioka, 1939.

241 individuals.

The largest specimens of this species were mature and well preserved. Although semi-transparent it retains its shape very well. The rayless regions of the lateral fins are well seen, and the anterior and posterior lateral fins almost touch one another. The seminal vesicle conformed to the *robusta* type as described by Tokioka (1939).

Formulae.

22 — 20	24 — 19	5 — 7	6 — 9	10 — 14
19 — 14	23 — 18	5 (6)	6 — 8	10 — 13
13 — 7·5	25 — 18	5 — 7	5 — 9	9 — 13

Sagitta regularis Aida.

Aida, 1897 ; Ritter-Záhony, 1911 ; Johnston and Taylor, 1919 ; Burfield and Harvey, 1926 ; Tokioka, 1939.

32 individuals.

This is a small form having a maximum length of 7 mm. though it appears to be mature at about 5 mm. It is a species which is fairly easy to recognize. Its opaque stiff body, complete set of fin rays, and rather cocoon-shaped seminal vesicle touching the posterior fin, make it rather like *S. neglecta,* but it differs from the latter species, especially in its smaller number of teeth, and in the voluminous collarette, which typically extends forward over the whole head from the front end of the anterior fin.

Formulae. ;

7 — 5	33 — 28	7 — 9	2 — 4	4 — 5
5 — 4	36 — 33	7 — 10	2 — 4	3 — 5

Sagitta robusta Doncaster.

Doncaster, 1903; Ritter-Záhony, 1911; Johnston and Taylor, 1921; Burfield and Harvey, 1926; Burfield, 1930; Tokioka, 1939 and 1940.

1298 individuals.

This was one of the commonest species in this collection. Tokioka (1939) has described a new species, *S. ai*, which is very closely related to *S. robusta*. The principal points of difference are stated to be in the length of mature individuals, the size of the head, the length of the collarette, the form of the corona and of the seminal veiscle. On examination of the best preserved specimens in the present collection, it was found to be impossible to separate them into the two species, although some of the features described for *S. ai* were seen in some individuals. Individuals range from 14·5 mm. to 6·5 mm. in length. The majority showed the features ascribed to *robusta*. Of the remainder there were a number which appeared to be quite mature, with seminal vesicles as described for *S. ai*, but they were only 10–12 mm. in length and the head was not comparatively larger than that of *robusta*. *S. ai* is said to be immature until it is more than 13·5 mm. long. On the other hand there were some specimens with several of the features given for *ai*, but with a very massive and extensive collarette characteristic of *robusta*. The measurements and numbers given in the formulae for the two species are also found to overlap almost completely.

The general formulae given for the two species are:

S. robusta	20	30 — 25	5 — 8	5 — 10	9 — 16
S. ai	19·5	30·4 — 26	6	7 — 10	11 — 15

This may therefore be an example of a variable species, and in this report all the specimens are considered as belonging to *S. robusta*.

Formulae.:

14·5 — 10	30 — 26	6 — 8	6 — 10	13 — 14
9 — 6·5	29 — 25	6 (7)	6 — 9	11 — 13

Sagitta serratodentata Krohn.

Krohn, 1853; Ritter-Záhony, 1911; Johnston and Taylor, 1919, 1921; Burfield and Harvey, 1926; Burfield, 1930; Bollman, 1934; Fraser, 1937; Tokioka, 1939, 1940.

180 individuals.

Tokioka (1939) describes a new species, *S. pseudoserratodendata*, which is very similar to the present species, and mentions that Aida noted that there was a large and a small form among the specimens of *S. serratodentata* collected from Japanese waters. In the present collection only one species can be identified with certainty. Tokioka states that *pseudoserratodentata* (1) is smaller when mature, (2) has fewer anterior and posterior teeth, (3) has a corona with the anterior end beginning at a slightly different position, (4) has a seminal vesicle of a somewhat different shape.

These characters were found represented to some extent individually in various specimens, but none were found with all the characters. In this connection it is noteworthy that Tokioka (1940) did not find any *pseudoserratodentata* in the eastern Australian collection examined by him. Moreover, in describing *serratodentata* in that collection from eight individuals, he notes that two show a variation in the seminal vesicle and that the number of posterior teeth in these two was less than in " the common Pacific individuals." Tokioka (1919) also describes for Japanese *serratodentata* a differing form of seminal vesicle. He therefore differentiates between a Pacific and an Atlantic or Mediterranean form, but with the exception of body length, the representative formulae which he gives for the latter form fall within the limits of the figures which he gives for *pseudoserratodentata*. It would seem clear that this species is definitely variable.* The reaching of maturity at a shorter body length may be connected with conditions, or may itself indicate a variable character. The longest individuals in the present collection were only 11·0 mm., but these and some shorter specimens appeared to be quite mature.

Formulae.

11·0 — 10	27 — 29	6 (7)	7 — 11	13 — 15
9 — 7	26 — 28	6	6 — 9	14 — 16
7 — 4	26 — 29	5 — 7	6 — 9	14 — 17

Krohnitta subtilis (Grassi).

Grassi, 1883, *Spadella* (part); Ritter-Záhony, 1911; Johnston and Taylor, 1919; Burfield and Harvey, 1926; Burfield, 1934; Tokioka, 1939 and 1940.

9 individuals.

These conform to previous descriptions. None appeared to be mature.

Formulae.:

10 — 6·5	32 — 36	7 (8)	11 — 14

Pterosagitta draco (Krohn).

Aida, 1897 (*Spadella draco*); Krohn, 1853; Ritter-Záhony, 1911; Johnston and Taylor, 1919; Burfield and Harvey, 1926; Burfield, 1930; Bollmann, 1934; Tokioka, 1939 and 1940.

22 individuals.

None of these were mature.

Formulae.:

7 — 4	45 — 40	8 — 9	7 — 10	10 — 17

* *Vide* also Burfield and Harvey, 1926.

SECTION II. DISTRIBUTION.*

A. Horizontal Distribution.

The total number of individuals of the various species which were caught at the different stations by day are given in the following table.

Table I.—*Total Numbers of Different Species of Chaetognatha Captured and the Stations at which they were Taken.*

Species.	Stations (3 mi. E.).	Total number.	Other stations.	Total number.
S. bedoti	2, 3, 5, 6, 9, 10, 14, 15, 61, 63, 66, 67	5848	1, 4, 8	59
S. bipunctata	14, 15, 18, 22, 27, 40, 52	299	11, 19, 28, 29, 45, 50	279
S. enflata	2, 3, 5–7, 9, 10, 12–15, 16, 17, 18, 22–25, 27, 30, 30A, 31–42, 47, 48, 51–61, 63, 66, 67	110,728	1, 4, 8, 11, 19, 20, 26, 28, 43–46, 49, 50	14,735
S. hexaptera	15	3	19, 20, 28, 45	64
S. lyra	45, 57, 58, 60	517	20, 28, 29, 45	117
S. neglecta	12, 14, 15, 16, 18, 22–25, 27, 30, 30A, 31–42, 47, 48, 51–59, 61, 63	26,904	19, 20, 26, 28, 43–45, 49	4816
S. pulchra	2, 3, 5, 6, 9, 10, 12–15, 23, 24, 31, 32, 36, 37, 39–41, 47, 51–59, 63, 66, 67	5326	1, 4, 8, 19	137
S. regularis	15, 16, 22, 41	174	19, 50	42
S. robusta	2, 3, 5–7, 9, 10, 12–15, 16, 17, 18, 22–25, 27, 30, 30A, 31–38, 40–42, 47, 51–61, 63, 66, 67	22,117	1, 4, 8, 11, 19, 20, 26, 28, 29, 44, 45, 49, 50	1720
S. serratodentata	6, 7, 15, 16, 27	243	19, 20, 50	837
K. subtilis	57	43	20, 28	39
P. draco	7	5	19, 20	74

Some facts with regard to the occurrence of the different species can be deduced from Table I, having regard at the same time to the actual abundance of the particular species concerned.

S. bedoti.—When present this was fairly abundant inside the reef but was very scarce outside. This is considered to be warm water form of the Indian and Pacific Oceans, and found from the surface to 50 metres.

S. bipunctata.—A scarce form in the present collection. Occurred sporadically both inside and outside the reef. Considered to be a eurythermous warm water form found from 0–50 metres in the Atlantic, Pacific and Indian Oceans.

S. enflata.—The most abundant species in the collection both inside and outside the reef. Some specimens were obtained from every haul taken. This species is typical of the warmest waters of the world, and has been recorded from the Atlantic, Pacific and Indian Oceans, and from the Mediterranean in the upper layers from 0–50 metres.

* All the numbers given in this section were calculated by weighting the numbers actually identified in the sample against the total numbers in the collection as given in the Tables in Vol. II, No. 6 of the Great Barrier Reef Reports.

S. hexaptera.—Very few individuals of this species were caught, and all of these with the possible exception of about three individuals were obtained from stations outside the reef. Only one specimen was mature. This is a warm water form found in the epiplankton of the Atlantic, Pacific and Indian Oceans.

S. lyra.—This species was captured in relatively small numbers, and was taken at only four stations inside the reef. None of the specimens was mature. This is described as a fairly deep water form in the sub-tropical zone of the Atlantic, Pacific and Indian Oceans, and also in the Mediterranean, but it has been captured near the surface.

S. neglecta.—This species was present in considerable numbers. It was taken at stations both inside and outside the reef, though many more at the former than at the latter. Many individuals were mature. It is a warm water species found in the tropical regions of the Indian and Pacific Oceans.

S. pulchra.—A fairly abundant form. Nearly all of the individuals were captured in hauls made at the 3 mi. E. station within the reef. This especially beautiful species is found in the epiplankton of the warmest waters of the Indian and Pacific Oceans.

S. regularis.—This was a rare species and was taken only four times at the 3 mi. E. station. Its distribution is similar to that of the previous species, being found in the epiplankton of the warmest waters of the Indian and Pacific Oceans.

S. robusta.—This was second in abundance after *S. enflata* at stations inside the reef. It has been recorded from the warmest parts of the Atlantic, Indian and Pacific Oceans. It is usually described as epiplanktonic, but it is suggested by Burfield and Harvey (1926) that it may also extend into the upper mesoplankton. In the present collection it should be noted that many individuals were obtained at stations 19, 20, 28, 29 and 50, where the maximum depth fished varies from about 200 m. to 600 m. It is therefore possible that at least some of the individuals were caught well below the surface waters.

S. serratodentata.—This species was present in medium abundance compared with others. It was obtained at five stations within the reef and at three outside the reef. The notable feature of the distribution is, however, that about three-quarters of the total catch was obtained outside the reef. This species is considered to be a eurythermous warm water form, and mainly epiplanktonic, though it does occur in the mesoplankton.

Krohnitta subtilis.—This was one of the rarest species in the present collection. Of these some specimens were taken at Station 57, 3 mi. E. and the remainder at two stations where the maximum depth fished varied from 200 m. to 600 m. This agrees with the recorded distribution of the species which is considered to be a eurythermous warm water form from both epi- and mesoplankton in the Atlantic, Pacific and Indian Oceans.

Pterosagitta draco.—This was also rare in the present collection, being taken at one station within the reef (7), and at two stations outside. All but five of the 79 specimens were taken at the latter stations. It is an epiplanktonic warm water species from the Atlantic, Pacific and Indian Oceans.

B. Distribution in Depth.

Chaetognatha were received from only one station (16) 3rd Oct., 1928, at which catches were taken with a closing net at different depths. At this station (3 mi. E.) hauls were taken for 10 minutes at each of six depths, including the surface. The complete data of the Chaetognatha obtained are given in Table II. The number of individuals of each species is given.

Table II.—*Total Numbers of Different Species of Chaetognatha Captured with Closing Net at Various Depths at Station* 16 (3.x.28).

Average depth fished (metres).	*Sagitta enflata.*	*S. neglecta.*	*S. regularis.*	*S. robusta.*	*S. serrat.*
Surface	6	13	0	8	1
3·1 M.	169	111	9	89	62
8	1504	97	23	188	40
11·1	1111	94	70	47	0
12·5	890	57	14	151	0
16·5	656	92	33	109	0

The above figures are given in the form of depth diagrams in Text-figs. 1–5.

These hauls were taken on a sunny day with a glass calm sea. The only conclusions which appear possible from the above data are that within the reef in October, under the conditions given, all the species were scarce at the surface, *S. regularis* not being present at all. *S. serratodentata* was found only down to about 8 m., and was mainly just beneath the surface. *S. enflata* became gradually less abundant in the deeper hauls with a maximum at 8 m., but *S. neglecta, S. regularis* and *S. robusta* showed no obvious sign of any considerable change in abundance, though *S. regularis* showed a maximum at 11·1 m.

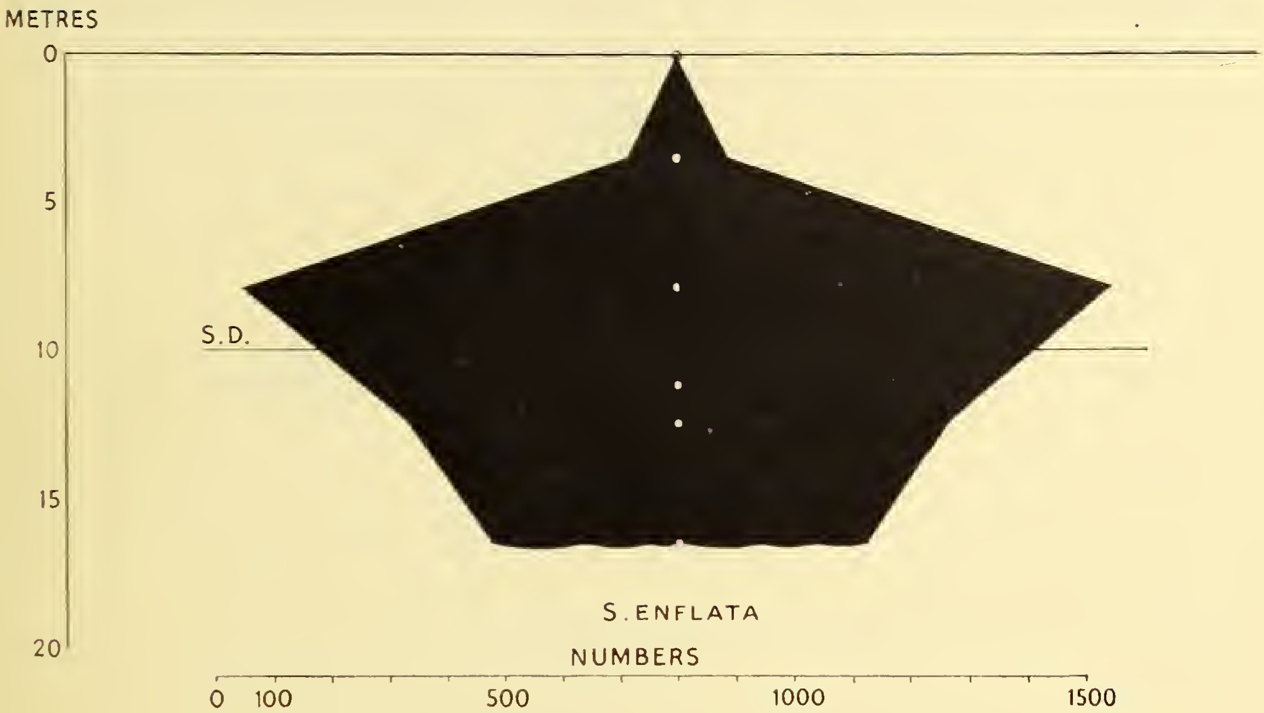
C. Distribution by Day and Night.

All the hauls so far considered in this report were made by day. There is only one night haul in the collection of Chaetognatha with precise data. This was Station 21 (3 mi. E.) on 22nd Oct., 1928, at which three half-hour hauls were made, two at 7.46 p.m.–8.16 p.m. and one at 8.40 p.m.–9.10 p.m. The maximum depth fished in these hauls was 20·5 m. for the first two and 22 m. for the third. No hauls were taken on the previous day, 21st Oct., so that the particular interest of these night hauls is found by a comparison of them with the hauls taken at the same location on the following morning, 23rd Oct., 1928. On that occasion (Station 22) two hauls were made from which Chaetognatha have been received. These were taken at 8.49 a.m.–9.19 a.m., and at 9.35 a.m.–10.05 a.m., the maximum depths fished being 20 m. and 20·5 m. respectively.

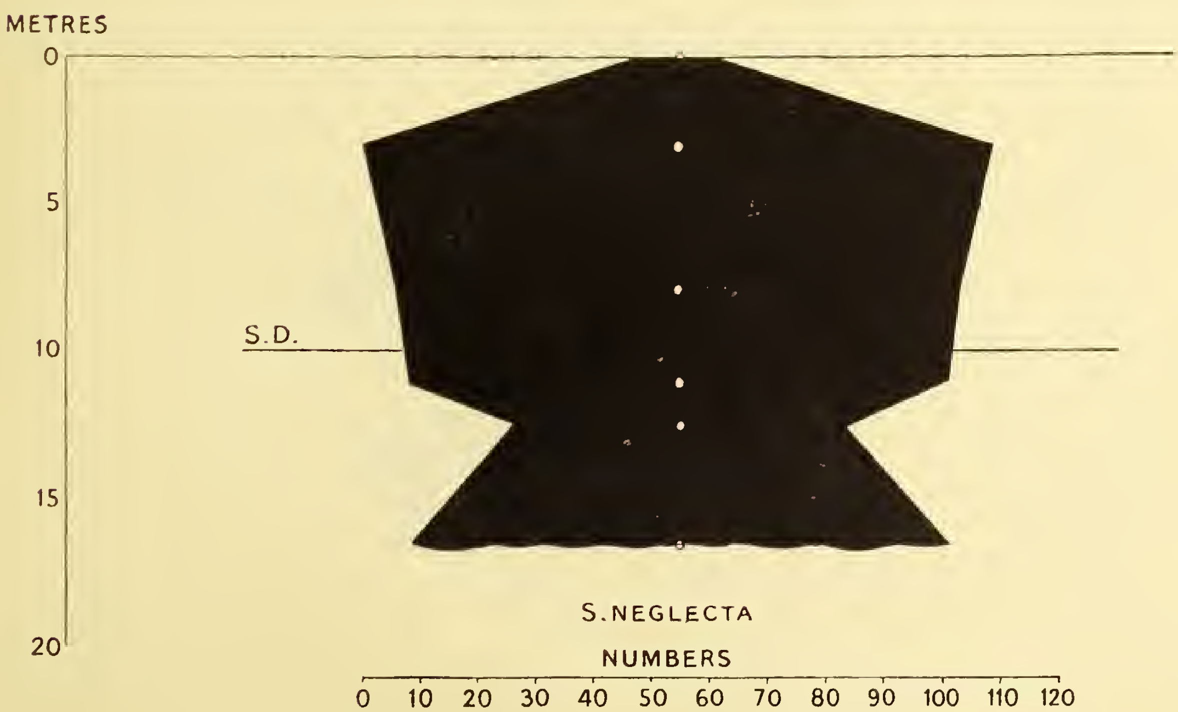
The data for all these hauls are given in Table III.

Table III.—*Numbers of Different Species of Chaetognatha captured in Three Night Hauls, Station* 21 (22.x.28), *and in Two Hauls taken at the Same Position on the Following Morning, Station* 22 (23.x.28).

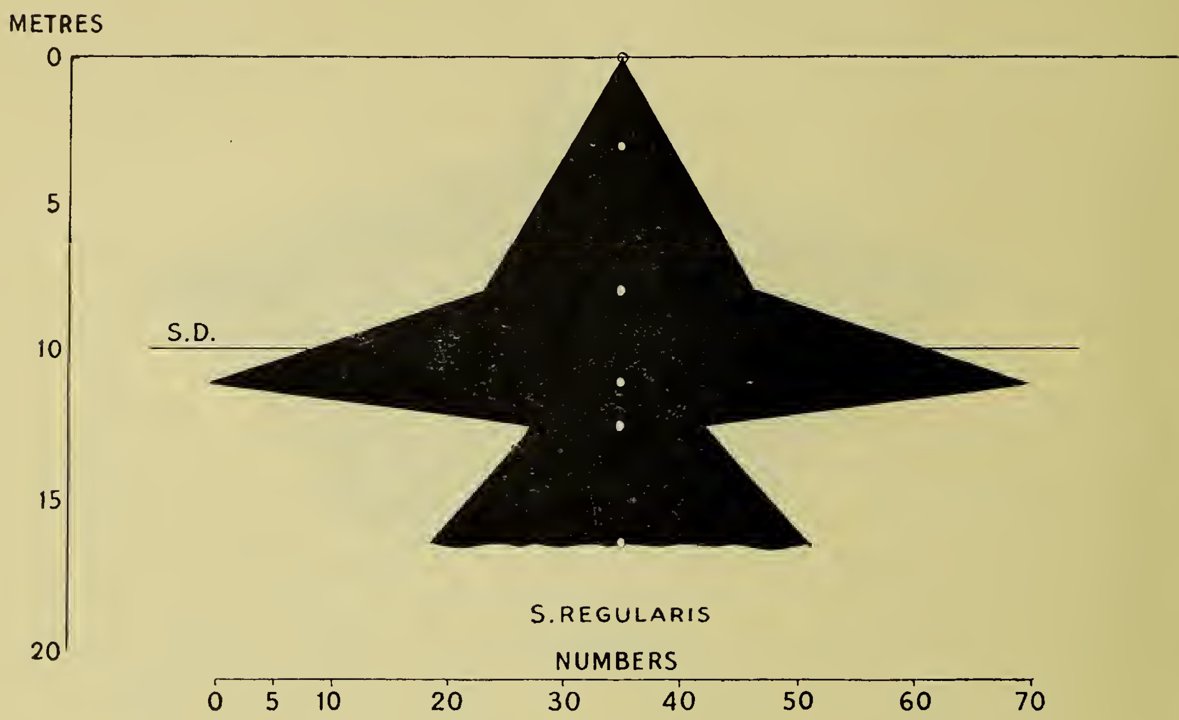
	Night, Oct. 22nd		Morning, Oct. 23rd	
	Total number.	Number per haul.	Total number.	Number per haul.
S. enflata	2970	990	145	73
,, *lyra*	7	2	0	0
,, *neglecta*	258	86	77	38
,, *pulchra*	160	20	0	0
,, *robusta*	578	192	137	68
,, *bipunctata*	0	0	7	3
,, *regularis*	0	0	15	7



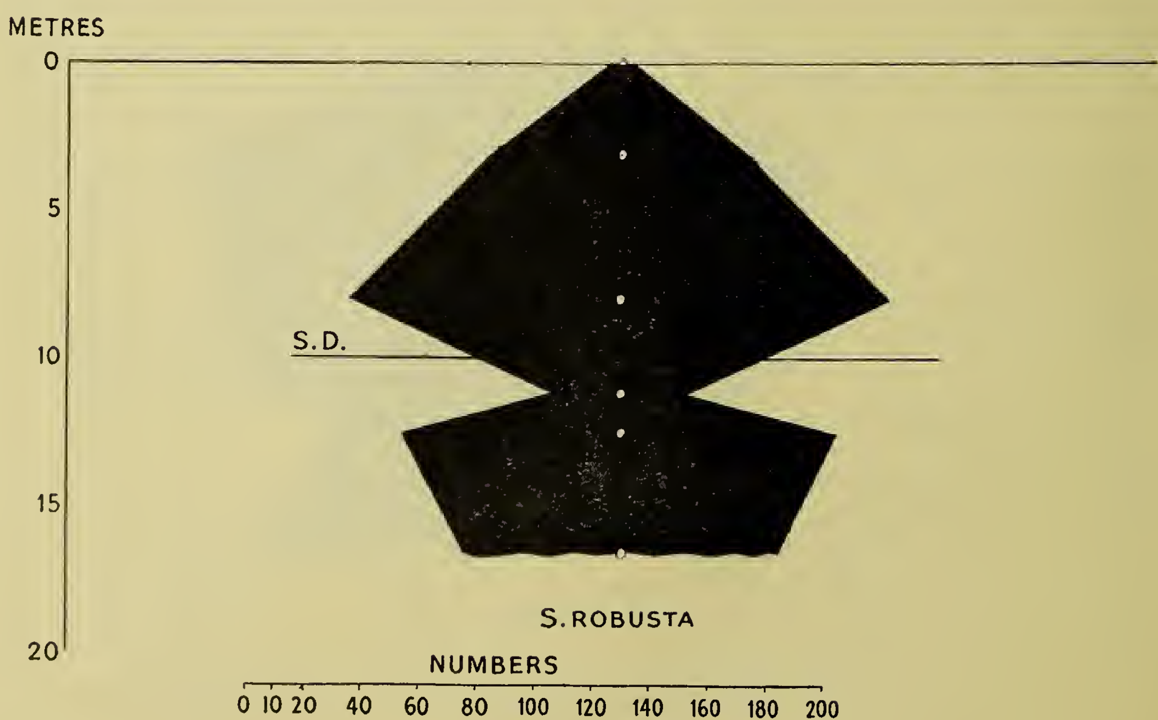
Text-fig. 1.



Text-fig. 2.

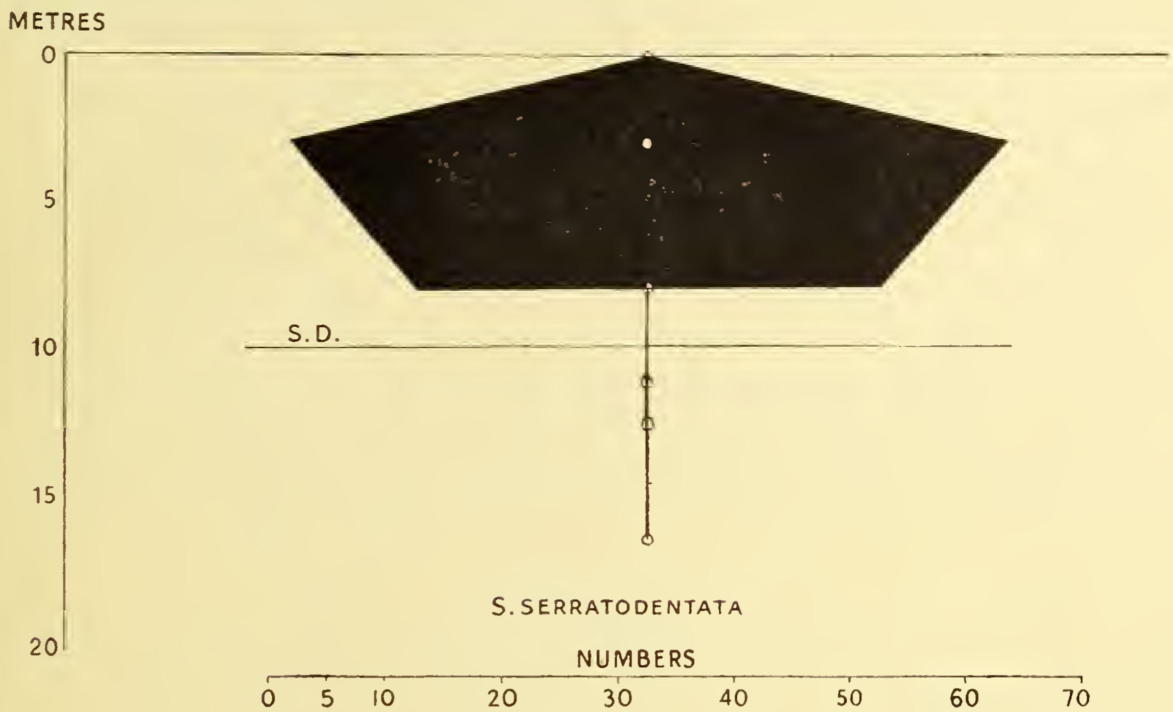


TEXT-FIG. 3.



TEXT-FIG. 4.

In so far as the numbers from these very few hauls indicate any movement of the Chaetognatha by night, it would appear that *S. enflata*, *S. neglecta* and *S. robusta* were more numerous at these depths by night than by day. *S. lyra* and *S. pulchra* were present only at night on this occasion, and *S. bipunctata* and *S. regularis* only during the day, though the numbers of the latter two species were very small.



TEXT-FIG. 5.

TEXT-FIGS. 1–5.—The vertical distribution of the different Species of Chaetognatha captured at Station 16. The circles and white dots indicate the average depths at which the hauls were made. Coarse silk townet. S.D., Secchi disc reading.

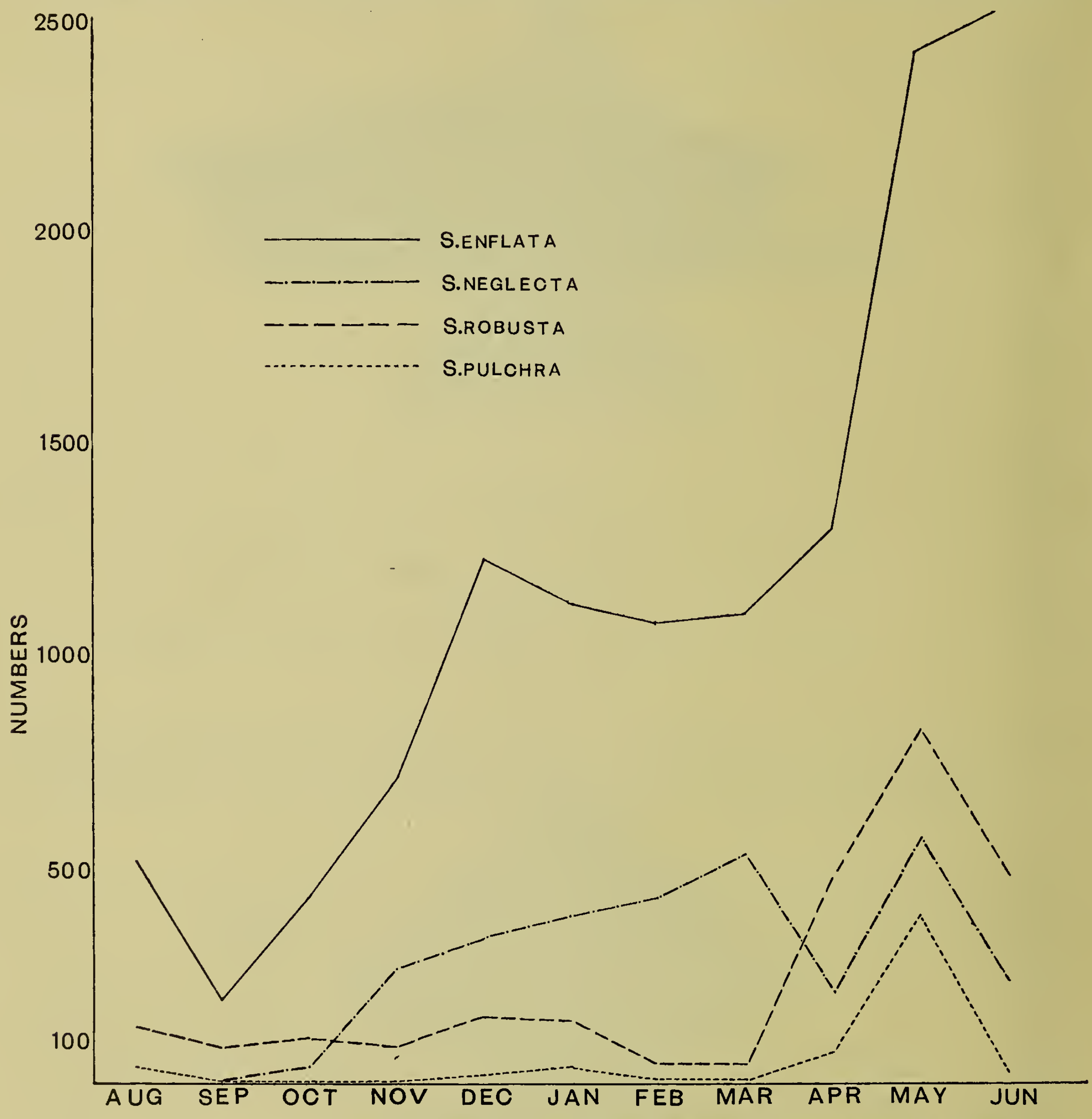
D. Distribution Throughout the Year.

At the station 3 mi. E. the presence (X) or absence (O) of the various species in the catches made from July, 1928 to July, 1929 by day is given in Table IV.

TABLE IV.—*Occurrence of Different Species of Chaetognatha in the Barrier Reef Lagoon.*

	1928.						1929.						
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
S. bedoti . .	×	×	×	×	○	○	○	○	○	○	○	×	×
,, *bipunctata* .	○	○	×	×	×	○	○	×	○	×	○	○	○
,, *enflata* . .	×	×	×	×	×	×	×	×	×	×	×	×	×
,, *hexaptera* .	○	○	○	×	○	○	○	○	○	○	○	○	○
,, *lyra* . .	○	○	○	×	○	○	○	○	×	○	×	×	○
,, *neglecta* . .	○	○	×	×	×	×	×	×	×	×	×	×	○
,, *pulchra* .	×	×	×	×	×	×	×	×	×	×	×	×	×
,, *regularis* .	○	○	○	×	○	○	○	×	○	○	○	○	○
,, *robusta* . .	×	×	×	×	×	×	×	×	×	×	×	×	×
,, *serratodentata*	○	×	○	×	×	○	○	○	○	○	○	○	○
K. subtilis . .	○	○	○	○	○	○	○	○	○	○	×	○	○
P. draco . .	○	×	○	○	○	○	○	○	○	○	○	○	○
Number of species	4	6	6	10	6	4	4	6	5	5	6	6	4

An interesting feature shown in Table IV is that the maximum number of species was present in October. This corresponds to the finding for the Siphonophora (Vol. II, No. 7, p. 270) ; October was the period of highest salinity, and it has been suggested that there is a greater survival of species brought in from the deep water under these conditions.



Text-fig. 6.—The average catches per haul of four different species of Chaetognatha for each month with the coarse and fine silk and 1-metre stramin nets, at the position three miles east of Low Isles, in the barrier reef lagoon.

Of those species which were present in the greatest number, *S. enflata* and *S. robusta* appeared throughout the year. *S. neglecta* was absent during July and August. *S. pulchra* was also obtained throughout the year and was fifth in order of abundance (*vide* Table I). *S. bedoti* was absent from November to May. The remaining species appeared sporadically and in relatively small numbers. It is therefore impossible to state whether any of these was entirely absent for a particular period in the year.

An attempt was made to discover whether the data of numbers caught of the most abundant species at the 3 mi. E. station would indicate any significant variations in abundance at different times of the year. To mitigate any effect of daily changes in the conditions the average number of individuals per 30 min. oblique haul for each month* was taken for each of the species *S. enflata*, *S. robusta*, *S. neglecta* and *S. pulchra*.

The results are represented graphically in Text-fig. 6.

The most noticeable feature applying to all four species is that they all show a period of maximum abundance in May.

S. enflata remained the most abundant species throughout the year, with a maximum in May and June and a minimum in September.

S. neglecta gradually increased in numbers from a minimum in September, to a maximum in May, with a temporary fall in April and a second fall in June. From November to March this species was second in abundance, but from April to June it was surpassed in numbers by *S. robusta*.

S. robusta was caught in medium numbers from August to March, but rapidly became more abundant in April and reached a maximum as the second most abundant species in May, falling off again in June, but remaining in the same order of abundance.

S. pulchra was taken in small numbers from August to March, but, as in previous species, then increased to a maximum in May, and fell off again in June.

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* The months of July, 1928 and 1929 have been omitted because Chaetognatha were received from very few hauls during these two periods.

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